Enabling Design

A Monograph
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Current operations indicate that improvements are warranted within our Battle Command (BC) planning method to support complex and ill-structured problems. Several modified approaches have been reviewed and synthesized into a general theoretical method currently addressed as Design. A practice of Design is necessary to facilitate the employment of Design theories. Design analysis so far has focused more upon the theory and less upon the actual practices of Design. Guidelines for conducting Design within Army forces do not exist within doctrine or SOP. There are no descriptive guidelines for the organization (team size, roles, and responsibilities), management (time, workflow, artifacts), or support environment (infrastructure and tools) of the design team. The Design practices identified within this paper address some of these gaps and can provide a baseline for additional guidelines or for tailoring by an operational force Design Team.

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Abstract

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Current operations indicate that improvements are warranted within our Battle Command (BC) planning method to support complex and ill-structured problems. Several modified approaches have been reviewed and synthesized into a general theoretical method currently addressed as Design. A practice of Design is necessary to facilitate the employment of Design theories. Design analysis so far has focused more upon the theory and less upon the actual practices of Design. Guidelines for conducting Design within Army forces do not exist within doctrine or SOP. There are no descriptive guidelines for the organization (team size, roles, and responsibilities), management (time, workflow, artifacts), or support environment (infrastructure and tools) of the design team. The Design practices identified within this paper address some of these gaps and can provide a baseline for additional guidelines or for tailoring by an operational force Design Team.

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Introduction

And it ought to be remember that there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

Niccolo Machiavelli[1]

This paper provides recommendations on the practice of Design. It provides these recommendations as a contribution to the evolution of the US Army Battle Command methodologies in tactical and operational decision-making. The paper strives to identify techniques and tools that may enable an Operational Planning Team to conduct Design activities more efficiently and effectively. These recommendations can then serve the Operational Design community of practice as guidelines on how to apply Design theories and concepts within operational forces. This paper is a product of synthesizing applied research. Applied research of Design practices identifies a baseline size and composition of a design group, appropriate venues and instruments, and considerations for modification. The Design practices identified within this paper should be understood as a baseline that can be tailored by an operational force Design Team.

A methodology is a reasoned approach to a type of work. Methodologies are organized to guide cooperative human activities in order to improve their performance by measures of effectiveness or efficiency. Methodologies may vary in purpose, scope, formality, structure, flexibility, situational suitability, and level of documentation. The structural elements of a robust methodology are likely to include applicable or associated

[1] Niccolo Machiavell, *Machiavelli: The Prince - Chapter VI*, 1515, http://italian.about.com/library/anthology/machiavelli/blprince06.htm (accessed March 12, 2009).

theory, principles/tenets, workflows, tasks, techniques, artifacts, roles, guidelines, best practices, patterns/anti-patterns, templates, examples, tools, environmental support, configuration and change management, quality controls, and associated project management techniques.

A methodology lies roughly in the middle of a cognitive continuum of organized activity abstraction. It may be useful to place a methodology in the context of a hierarchy (see Figure 1). In such a view, a methodology will lack the precision of technique but will be a firmer guide to action than a philosophy.[2]

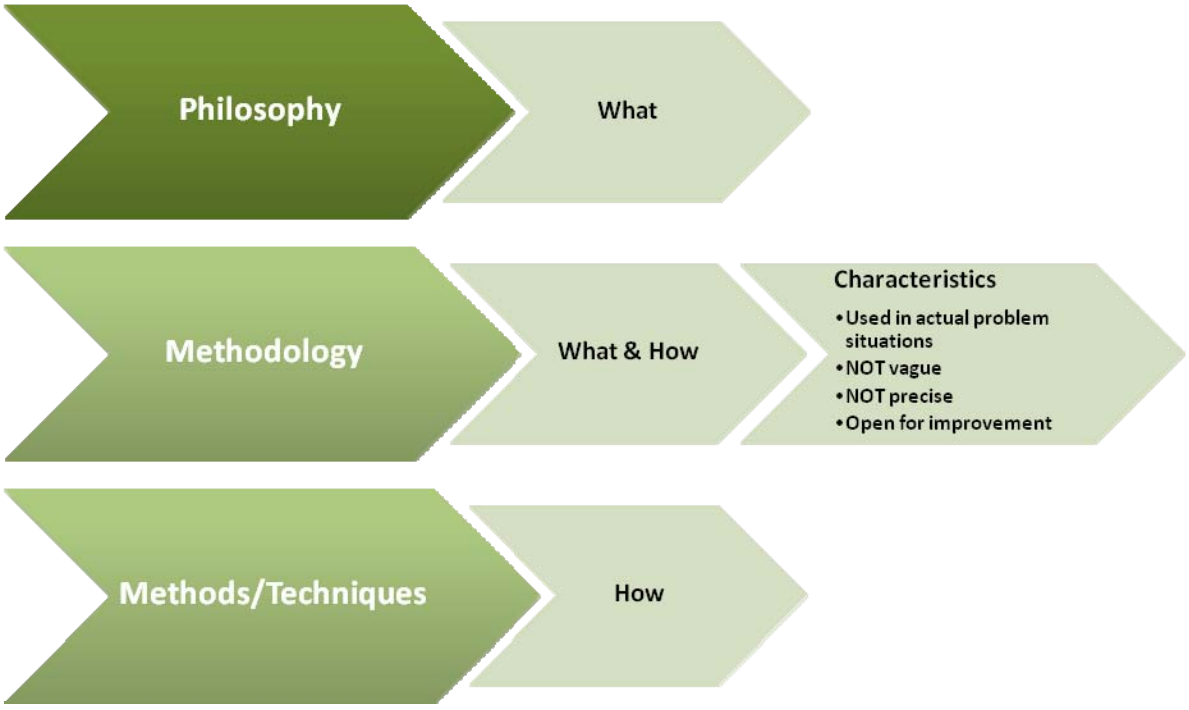

Figure 1. Methodology in Hierarchical Context.

[2] Peter Checkland, *Systems Thinking, System Practice*, (Chichester: John Wiley & Sons, 1981), 181.

Within the continuum, methodologies bridge the realm between theories of work and the physical tasks or actual work. Methodologies are generally practical approaches that can be applied in actual situations. Methodologies can be fairly large and comprehensive compositions; drawing upon numerous philosophic or theoretical components as well as incorporating numerous methods and techniques, all to be applied to a substantive and multifaceted work effort. Methodologies may be used independently or be integrated, sequenced, and nested with other methodological approaches as seen fit within an enterprise and given the circumstances of the situation. As they are compositions of components, a methodologies construction lends itself to change through substitution or modification of loosely coupled components. This attribute of composition cannot be applied in the same way to philosophies or methods/tasks. Philosophies are generally too abstract and boundless to be easily "swapped out for a new one". Individual tasks are essentially atomic and indivisible and are therefore not readily composable in the same way a methodology is. For these reasons, methodologies lend themselves to incremental change and commonly evolve via trial and error as practitioners adapt the various elements of the methodology to support their current circumstances. Poor performance of a methodology (or an aspect of a methodology) within its intended application environment stimulates the methodologies community of practice to evaluate the shortcoming and to either:

- Adapt the core approach,
- Develop a methodology variant,
- Adopt a different approach, or
- To develop an alternative approach more suitable to the conditions.

However, changing a methodology is not a simple rational or mechanistic matter; instead it is bound to the human dynamic of the organization and the individuals that

compose it. In most people and organizations there is a general and strong reluctance to change those things that have come to be accepted. For good reason, those things under consideration for change, probably came about for good reasons sometime in the past—even if those good reasons have been forgotten in the present. This sense of caution is evident if you are speaking of changing something as profound as an enterprise methodology. When organizations recognize that a major change may be called for, they are most comfortable approaching the decision cautiously—testing, experimenting, and if possible making identified changes gradually and incrementally.

The management of change within any organization is an important leadership interest and challenge. The nature of a change varies: some are malignant, some are benign, and some are healthy in narrow circumstances, and some are good for the long term success of the organization—some are even necessary to survival. However, virtually all organizational change of note is controversial to those stakeholders that are impacted. The implementation challenges are magnified when the change:

- Must be made by many individuals;
- Has to be made or accommodated by the leadership of the organization;
- Occurs in a large organization;
- Alters or is contrary to the organization's cultural values;
- Impacts a core function,
- Impacts directly the success and reputation of the organization;
- Requires a major investment of resources;
- Cannot be or is difficult to reverse course or correct;
- Impacts personnel strength or personnel policy;
- Utilizes unconventional, unproven, or unfamiliar technology; or
- Is based upon unusual or unfamiliar philosophies, theories, concepts, or techniques.

A change in an organization's core methodology is a fundamental example of a major leadership challenge. However daunting the challenge, change frequently means the difference between success and failure, and sometimes it even impacts the survival of the organization. It is for this reason that the organization's leadership has to seriously

manage *what*, *when*, and *how* to change. In other words, change management within an organization must be one of the leaderships' primary tasks.

If one is charged as a change agent for such an endeavor, one should acknowledge the dynamics involved and take steps within the introduction of the change to ameliorate excessive reactions and natural frictions. One method of doing this is by providing implementation guidance in such a way as to avoid misunderstanding and confusion. The necessity of change should be communicated in addition to the details of *what* and *how* things must change. A change agent is not going to completely eliminate the challenge or controversy. But the change agent can seek to minimize the friction that the methodological change is subject to. Unsuccessful management of the change can stall an otherwise useful adaptation. In the process of change, it is difficult to surmise the ultimate wisdom or the potential folly of change itself; luckily, the quality of its change management is slightly more transparent in execution. When the challenges to change shift from outright rejection, emotional attacks, and disputed justification to matters of *when* and *how* to implement change; then the change has probably reached an organizational tipping point and the likelihood of acceptance and successful implementation are now much higher.

An evolution of Battle Command methodologies used in tactical and operational decision-making is ongoing. A change is being advocated which would use a different methodology to conceive operations under those circumstances that current doctrinal planning approaches are less well suited to support.[3] Those unique circumstances are those where national security or a military organization is being challenged by an ill-structured problem and a complex adaptive system. Given the critical role of the military

[3] BG (Retired) Huba Wass de Czege, "Systemic Operational Design: Learning and Adapting in Complex Missions," *Military Review*, (January-February 2009): 2-12.

to the survival of a society, a change in the way its military plans it operations could ultimately have historical significance. *Design*, as an evolved Battle Command methodology form, is being advanced (or reemphasized—depending upon your perspective) to extend, augment, and inform United States Army planning doctrine. The use of Design techniques is a significant, if not profound, change to the US Army's doctrinal planning methodology.[4] Time will tell whether the advocated change was well conceived and well managed; but it appears that resistance to the use of Design within the US Army is decreasing. The details of Design's formal role in future planning doctrine is being discussed, but its impact on, and the importance of it within, our planning doctrine is generally accepted within the planning community of practice as evidenced by the favorable reception of draft Design doctrine under staffing. The institutionalization process is beginning. The more general aspects of design are being incorporated within doctrine. Design is being used with Army experimentation efforts and the Army education system has begun to incorporate the shift. We are now beginning to address the details of *How* to change but there are additional aspects to Design that must be clarified.

If a new concept is to be accepted and exploited, we have to either develop the practical aspects that allow it to be integrated it within the accepted and practiced methodology; or we have to craft a standalone practice to support the concept as a new or alternate methodology. Design's practitioners must now employ their *practical* critical thinking skills in order to translate abstraction and theory into realistic application.[5] This

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[4] The Military Decision Making Process (MDMP) and the Joint Operation Planning Process (JOPP) are the respective doctrinal planning processes for the US Army and for US joint forces.

[5] COL Steve Banach, *"The Art of Design After Action #1 briefing"* (briefing presented at Fort Leavenworth: School of Advanced Military Studies, Fort Leavenworth, KS, November 6, 2008), Slide 4. During the AAR COL Banach reviewed the development of critical thinking skills by correlating the three cognitive domains (analysis, synthesis, and practical), the SAMS Design curriculum, and their application within the just completed Practicum exercise.

knowledge must be made practical for a general audience of staff officers, commanders, and other relevant stakeholders. In order for a moderately sized group to support and participate in the methodology, the methodology needs to be coherent and complete; not vague and inexplicable. This translation and practice development (i.e. methodology development) can occur from scratch for each headquarters or each Design event but preferably the Army's planning community of practice can begin to describe a uniform and common practice of Design suitable for training and employment.

In order to employ Design as a standard methodological form within the Army some of the basics of the practice need to be considered. It is possible that the positive impact of Design in our Army may be solely based upon the utility of its practitioners' in-depth knowledge of Design's advanced concepts and theories. However, it is more likely that it will instead rest upon those practitioners' ability to apply those concepts in concert with more mundane but important practical management tasks, such as how to organize and support the team to perform Design well. This paper attempts to provide answers to just a few of these outstanding questions related to the practice of Design.

Purpose

The purpose of this paper is to provide guidance and tailoring considerations on the organization and support of an operational planning team conducting Design. Utilization of this guidance enables an Operational Planning Team to conduct Design activities more efficiently and effectively. The considerations provided shall facilitate adaptation of the guidelines to novel or exigent circumstances. Overall, the paper provides select guidelines to the Design community of practice in order to more effectively apply Design theories and concepts within operational forces. The guidance and considerations contribute to the evolution and maturity of our overall Battle Command methodology.

Background

The evolution of a coherent Battle Command methodology is motivated by a number of factors. The evolutionary pressure is established by the perceived future needs in the context of historic and current methodologies and the lessons learned drawn from their use. This perception or awareness of a methodological shortcoming creates a pressure to change. This pressure to change has to be accommodated within the constraints of the organization, its infrastructure, and the available technology to holistically support the desired change.

The US Army requires the capability to plan and conduct a wide variety of challenging operations. The US Joint Forces Command (JFCOM) provides a projection of the likely challenges that the US will face within their Joint Operating Environment (JOE) report.[6] They describe a number of dangerous trends that influence the world's security and serious regional issues and threats that provide context for future conflict. The Institute for National Strategic Studies (INSS) reinforces these projections and stresses our need to prepare for these global challenges and to prepare means necessary to meet them.[7] Among their preparation recommendations is an emphasis on planning that: balances military and political actions; includes interagency members and capabilities, provides specific solutions to meet local conditions; supports stabilization, security, transition, and reconstruction operations; addresses a variety of threats, and that recognizes the indispensable contribution of multinational coalitions. These futures

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[6] Center for Joint Futures (J59). *The Joint Operating Environment (JOE): Challenges and Implications for the Future Joint Force*. Study, Suffolk, VA: US Joint Forces Command, 2008.

[7] Institute for National Strategic Studies. *Strategic Challenges: America's Global Security Agenda*. (Edited by Stephen J. Flanagan and James A. Schear. Washington, D.C.: National Defense University Press and Potomac Books, 2008), 54, 56-58, 286-287, 294, 320-323.

describe situations that will require Army commanders and staffs to plan operations within a complex adaptive system and manage ill-structured problems.

These challenges constitute a need for an alternative or enhanced planning methodology—hence Design. Some have argued that there is room for improvement of our current methodologies (i.e. JOPP and MDMP) .[8] Within the INSS book, *Strategic Challenges*, James Schear has identified a number of lessons learned from the US experience in Afghanistan and Iraq that inform a discussion on planning and design.[9] He makes the following points: post-intervention stabilization activities should be prioritized; a culture reform throughout government (including the military) is needed to overcome interagency performance problems; integrated interagency mission planning is necessary, and that agencies must overcome coordination inhibitions, and that regional experts should be used in planning. He states, "The key element for stabilization planning, at either the strategic or operational level, is to ensure the process includes regional experts who know a given region's sociopolitical environment, program managers and specialists who know the instrumentalities to be utilized by the mission, and strategists who can bridge both worlds and offset the parochialism of the other two communities". He also advocates that planning should include rigorous alternative scenarios, realistic assumptions, regional environment/context, and consider linkages to international and regional organizations.

These critical insights are not new to Iraq and Afghanistan. Analysis of the reconstruction and nation building operations immediately following Operations Just

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[8] BG (Retired) Huba Wass de Czege, "Systemic Operational Design: Learning and Adapting in Complex Missions," *Military Review*, (January-February 2009): 2-6.

[9] James A. Schear, "Defusing Conflicts in Unstable Regions," In *Strategic Challenges: America's Global Security Agenda*, (edited by Stephen J. Flanagan and James A. Schear, Washington, D.C.: National Defense University Press and Potomac Books, 2008), 110-148.

Cause (i.e. Operation Promote Liberty, earlier known as Blind Logic) by Richard Schultz identified additional relevant and supporting issues.[10] His insights specific to planning methodologies were: planning must begin with a clear understanding of both the immediate situation and the historical and cultural context of the territory involved; leadership should be involved in planning all phases of the operation, planning should not be compartmented, services do not have the expertise to plan stability operations, interagency approaches are a prerequisite for future situations, and finally not to bifurcate the warfighting and post conflict restoration phases/operations.

Contemporary insights regarding shortfalls in our operations and planning doctrine are motivating updates within doctrine. James Schear provided a compelling argument that recent experience within Iraq and Afghanistan has reemphasized the need for additional emphases on civil considerations within military analysis and the advantages of using a "whole of government" approach to societal and state problem management.[11] This reemphasis is also demonstrated within a number of updated doctrine manuals. The Operations (FM 3-0), Counterinsurgency (FM 3-07), and Stability Operations (FM 3-24) field manuals have been published or republished in the last three years. All address the need for the US Army to plan and conduct operations within the environment (complex and ill-structured) that Design is oriented towards.

In the light of their own experience and contemporary commentary, the military planning community of practice has focused much of its attention in the last few years on the analysis and synthesis of the theories supporting the art of design. Few analysts have

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[10] Richard H. Shultz, Jr., *In the Aftermath of War: US Support for Reconstruction and Nation-Building in Panama Following Just Cause*, (Study, Maxwell Air Base, AL: Air University Press, 1993), 67-71.

[11] James A. Schear, "Defusing Conflicts in Unstable Regions." In *Strategic Challenges: America's Global Security Agenda*, (by James A. Schear Stephen J. Flanagan, Dulles, VA: Potomac Books, 2008), 133-147.

made in depth attempts to address the practical aspects of the theories.[12] The community of practice discourse addressing the tensions between the process aspects of a Design method and the unstructured, creative, iterative aspects of the design philosophy has drawn the majority of leadership attention and is still under scrutiny.[13] In doctrinal maturity, the tensions between these needs should be resolved and balanced, acknowledging the flexible need for both within the military planning domain. Although these community issues are still under discussion, most of the defining organizational and support needs are unlikely to change; and so may be developed and incorporated with our community of practice methodology.

The stability of needs is due in turn to the general stability of the military planning problem and the human organizational dynamic. Warfare shall remain a social phenomenon with political aims.[14] The tenets and patterns of war have been fairly consistent in the modern era and many would argue that they have been consistent historically. The major factor inserting variation within the contemporary calculation of needs, and specific to Design, is the critical reemergence and emphasis of, atypical military considerations within the development of our military situation understanding

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[12] Although many theorists and analysts have begun to address practical matters of Design within their discussions of theory, most have not developed detailed practices. John F. Schmitt's paper, *A Systemic Concept for Operational Design* comes to closer than others to providing a comprehensive methodology. John F. Schmitt, "*A Systemic Concept for Operational Design*," Vers. 1.0. Air War College, Air University, Marine Corps Warfighting Laboratory, 2006, http://www.au.af.mil/au/awc/awcgate/usmc/mcwl_schmitt_op_design.pdf (accessed March 12, 2009). Although specific to a form of design, the team monograph written after Unified Quest 2005 provides many insights into the practice of Design. LTC William T.Sorrells, LTC Glen R. Downing, MAJ Paul J. Blakesley, MAJ David W. Pendall, MAJ Jason K. Walk, and MAJ Richard D. Wallwork, *Systemic Operational Design: An Introduction*, Monograph, School of Advanced Military Studies, Command and General Staff College, Fort Leavenworth: United States Army, 2005.

[13] COL Tom Roe, interview by Brad Gill, (October 2008).

[14] BG (Retired) Huba Wass de Czege, *Lessons from the Past: Making the Army's Doctrine "Right Enough" Today*, (Landpower Essay, Institute of Land Warfare, Arlington: Association of the United States Army, September 2006), 18.

and unified action solution.[15] This is not so much a change in need but more a reevaluation of the priority of stability operations within the doctrine and training of the US Army coupled with a subtle shift in the scope of responsibilities of the military versus civil government organizations. Some, like British General Rupert Smith, may argue that the frequency of "war among the people" make them the norm versus "wars among states". However, frequency of occurrence should not be the solitary factor driving military doctrine and training. The military of a state is charged with insuring the survival and prosperity of the state through use or threat of force. Within either case within the modern era the scale, costs, and potential global impact of warfare now require deliberate planning by a commander and staff and collaborative planning with those in their roles within supporting, subordinate, superior, and proximate forces; as well as with those in cooperating and consulting agencies and organizations. This necessary military planning is almost by definition dependent upon the effectiveness of the humans to work effectively together and must be capable of managing the complex challenges of the future Joint Operating Environment.

Although some Design institutionalization issues remain, they do not significantly impact the subject of this paper. The major planning/design adaptations that are still undetermined relate to the manner used to doctrinally blend the cognitive and iterative design activities with the more sequential design procedures. These adaptations can be considered independently from the subject of this paper.

Given this general context for Design we can now turn to more specific aspects design support within a methodology. Our headquarters are not staffed to independently

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[15] Rupert Smith, *The Utility of Force: The Art of War in the Modern World*, London: Penguin Books, 2005, 182, 267-269, 278-291.

conduct Design in all conceivable contingencies. Nor do our headquarters have information technologies optimized to support Design activities.

Scope

This work is scoped by its contextual subject (i.e. Design) and the select aspects assessed within the subject (i.e. the organization of the Design team and its supporting infrastructure). Within the team organization sections, guidance and considerations shall be offered to facilitate team member selection, the various roles within the team, and the size of the team. Within the team support sections, guidance and considerations shall be offered to facilitate the provisioning and setup of a design venue, useful design information technologies, and an overview of design information. The final support section addresses guidance and considerations regarding the use of time within a design effort.

Due to limitations of time, many aspects of analysis are not included. For example, the practical application of theories and concepts of design within workflows are not addressed. The individual, practical techniques (such as system mapping) that are used within a Design workflow are also not covered.

The lack of procedural detail constrains this analysis. The specific workflows and individual techniques and methods utilized within the workflows are necessary to fully refine the team organization and are critical to the full development of some team support approaches (e.g. tailored information technologies supporting the organization roles, the sharing of information, and the development and integration of Design software applications). This analysis is limited by both the current lack of standardization and the level of doctrinal detail available within this emerging methodology. Regardless of this limitation, some high level tasks/functions have to be assumed from the current state of

Design's functional/task analysis. These activities are synthesized from a few Design references and current doctrine. The synthesized team activities used for this analysis are:

- Prepare for Operations
- Manage Information
- Assess Situation
- Collaborate
- Develop Strategies

One of the sources was the TRADOC Design concept. In this 2008 description of Design (see Figure 2. CACD Design Activities) you find the following high level team activities.[16]

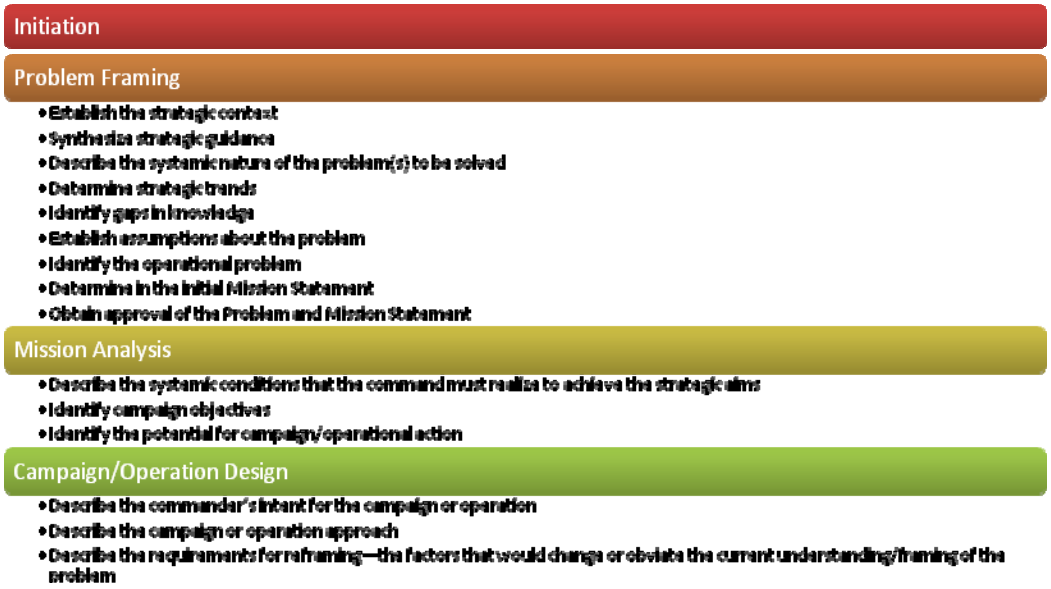

Figure 2. CACD Design Activities

A simpler description is provided by both the Art of Design Student Text[17] and by Brigadier General Wass de Czege[18]. In these references the essential tasks are to:

[16] Headquarters, United States Army Training and Doctrine Command, *TRADOC Pamphlet 525-5-500 Commander's Appreciation and Campaign Design*, Version 1.0, (Fort Monroe, VA: Department of the Army, 2008), 21-29.

construct the conceptual frame of reference—the Systems Frame; and 2. Construct a narrower conceptual frame of reference—the Operations Frame. These activities can be mapped within the CACD activities and paraphrased within this analysis as *Assess Situation* and *Develop Strategies*. CACD uniquely identifies the activity *Initiation* paraphrased within this analysis as *Prepare for Operations*. The term *Prepare for Operations* is more consistent with current doctrine in FM 6-0 and FM 7-15.[19] The activities *Manage Information* and *Collaborate* are both assumed in most writings on Design but are required for the analysis of supporting information systems. The tasks itemized in the figure (see Figure 3. Design Team Tasks/Operations) provide sufficient detail to begin the analysis of the Design Team and its enabling support items.

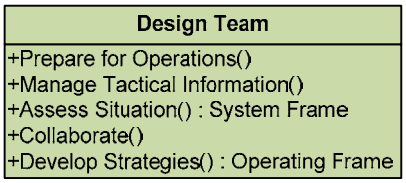

Figure 3. Design Team Tasks/Operations[20]

It should be noted that most of the considerations suggested within this paper should be applied within the first phase of the Design activity—that is *Initiation*.

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[17] School of Advanced Military Studies, *Art of Design Student Text*, v. 1.0, (Edited by Booz Allen Hamilton, Fort Leavenworth, Kansas: U.S. Army Training and Doctrine Command, 2008), 26.

[18] BG (Retired) Huba Wass de Czege, "Systemic Operational Design: Learning and Adapting in Complex Missions," *Military Review*, (January-February 2009): 8.

[19] Both FM 6-0 Mission Command: Command and Control of Army Forces and FM 7-15 Army Universal Task List consistently use the terms: Manage Tactical Information, Collaborate, Prepare for Operations, and Assess Situation. *FM 6-0 Mission Command: Command and Control of Army Forces*, (Washington, D.C.: U.S. Department of the Army, 2005). *FM 7-15 Army Universal Task List*, (Washington, D.C.: US Department of the Army, 2006).

[20] When applicable, technical drawings used within this paper shall be developed using the Unified Modeling Language (UML). Common UML semantics and symbology are described in Annex A Unified Modeling Language Supplement.

Design Team Organization

An organization is a system of cooperative human activities…[21]

Chester I. Barnard

This section will provide recommendations regarding the organization of the Design Team. It will provide organizational considerations for a leader preparing to conduct Design. This section will discuss the use of sub-groups, personnel roles, personnel sources, and group size. It will attempt to fill the gap in current doctrine regarding Design Team organization. Currently, there is little or no doctrinal guidance on the organization of a Design Team. The team organization is not referred to within our operations, command and control, or planning doctrine or concepts. There are some related discussions within the Art of Design Student Text from the School of Advanced Military Studies.[22] These will be highlighted within the section when appropriate.

The formation of the Design Team must consider human organizational dynamic. Aspects of this dynamic do not really change although our understanding of them continues to mature. Variation in the dynamic is created by the unique nature of each individual. A leader preparing to conduct design has to be cognizant of the human dynamic when assembling the individuals to perform the team mission efficiently and effectively. For example, organizations are more effective when there is an appropriate degree of role specialization. Likewise, teams can be too small, too large, too homogeneous, or too heterogeneous. There are many interacting factors affecting a

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[21] Chester I. Barnard, *The Functions of the Executive*, (Harvard University Press, Cambridge, Mass., 1971), chap VI. A formal organization is: "A system of consciously coordinated activities or forces of two or more persons."

[22] School of Advanced Military Studies, *Art of Design Student Text*, v. 1.0, (Edited by Booz Allen Hamilton, Fort Leavenworth, Kansas: U.S. Army Training and Doctrine Command, 2008), 38-59.

Design Team. Due to their number and diversity their interactions are difficult to quantify for a given situation. However, simply understanding that they are a factor allows them to be consciously considered. For example of the factors, a study of the effectiveness of military team, identified following dimensions affecting the state of coordination between team members:

- Collaboration system characteristics
    - Synchronous versus asynchronous collaboration: Is the collaborative process conducted in a same time manner or are participants collaborating at different times?
    - Proximity of collaborators: Are the participants located proximally or are individuals geographically distributed?

- Team characteristics
    - Command structure: Are the participants organized in a hierarchical or a flat structure?
    - Homogeneity of knowledge: Do all participants possess the same knowledge or is there information asymmetry?
    - Team size: How many individuals are required to collaborate on a team?

- Task dimensions
    - Collaborative output: Is the goal of the team to deliberate and process information or to determine a course of action (COA)?
    - Time stress: Is the team subject to time pressure?
    - Task complexity: How large and complex is the task?
    - Task familiarity: Is the task a onetime or a recurring event?
    - Nature of constituent subtasks: e.g., whether subtasks involve planning, decision making, cognitive conflict, creative and intellective subtasks etc.[23]

Should You Split the Team?

Some circumstances will warrant splitting the team into subgroups or multiple discourse groups. A Design Team at its essence is a single, unitary discourse group conducting Design. Splitting the team into multiple, temporary discourse groups facilitates parallel activities to be conducted by the various groups. The discourse groups

[23] Chris Burnett, Joseph A Giampapa, Dr. Gita Sukthankar, and Dr. Katia Sycara, *A Model of Human Teamwork for Agent-Assisted Search Operations,* (NATO, 2008), 5.

can be oriented on a special aspect of the Design, for example an in depth analysis of the economy; or the production of a draft design artifact. Smaller teams may be more efficient than the larger group during some activities. This is quite likely if the team is very large i.e. greater than nine members. In some circumstances there may be excessive friction between some members of the team. Separating them for a period may allow the team to avoid the personality clashes and make some progress. Therefore, splitting the team into multiple discourse groups may be appropriate when time is constrained, the group is large, or if splitting the group facilitates group dynamics.

Although some time savings may be achieved by use of this method, there are drawbacks to this technique as well. While segregated, the learning processes of the various discourse groups diverge. Differences in knowledge and reasoning develop. This dissonance may be mitigated by having the groups frequently (e.g. every 2-4 hours) reconvene and back brief what they have learned or produced. This team resynchronization session may still be problematic in a couple of ways. It may take a considerable amount of time for the reunited team to absorb, reflect, and apply their critical thinking to the new information. Therefore, the time saved by splitting the group may not be worthwhile if considerable discourse is still necessary. Therefore, splitting the group is best used early within the process when basic research is being conducted or when you need a quick product to stimulate large group discussion. The groups should also be kept physically close to allow for the teams to collaborate informally when questions come up. The second issue that may manifest when using multiple discourse groups is that the groups are likely to only communicate a portion of their understanding. This is turn potentially weakens the consistency of the team's knowledge and understanding. The third issue that may manifest is that the large team may not challenge the sub-group information and insights, which may introduce poor logic or limit a more expansive analysis. Therefore, splitting the team into subgroups is not always advisable.

If the use of sub-groups is warranted, then the leader should organize the sub-group as if it were a very small Design Team. The same general considerations must be made e.g. size, diversity, roles, use of time etc. In addition, the number of subordinate discourse groups should not be excessive.

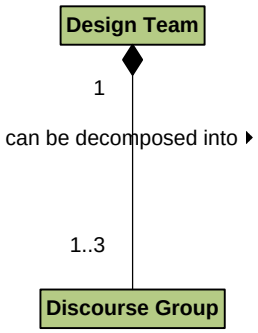

Figure 4. Discourse Group

The more sub-groups that are employed, then the longer the resynchronization periods must be and more likely that the negative issues shall manifest. If the number of subgroups is excessive, the resynchronization time will exceed the cost saved by splitting into sub-groups.

How is the Team Selected?

Our senior headquarters Plans Sections provide some but not all of the expertise to assist the commander in the conduct of Design. These sections have plans officers that are highly educated in a number of critical strategic concepts and additionally have specific functional area expertise necessary to conduct detailed planning. Unfortunately, these officers are neither regional area experts nor are they experts in all the non-military elements of national power. They do not have the socio-cultural expertise to manage ill-structured problems throughout the world without some outside assistance. The breadth

of military situations that the Army may face precludes it from developing specific knowledge for all but a few contingencies. Some form of augmentation is necessary.

The organization of a team is one of, if not the most, significant project management responsibilities made by a leader. The team composition directly impacts the team's effectiveness and efficiency—which in turn, impacts the success of the team's unit mission. The organization of the team should consider the unique characteristics of the task at hand, the methodology that best serves the problem to include the roles to be performed, the personnel available with their own respective characteristics, and finally the collective capacity and capability of the personnel. This situational interplay of needs, capabilities has to be balanced with team size and time constraints (see Figure 5. Team Organization Considerations).

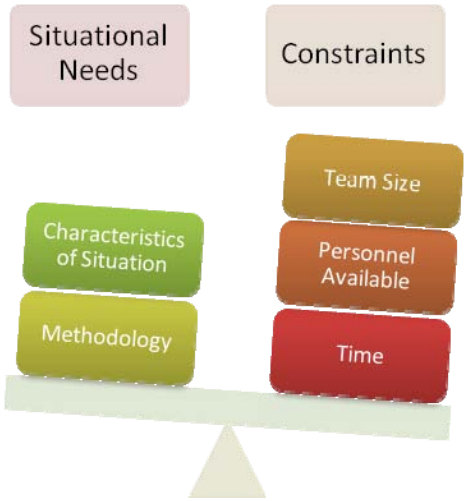

Figure 5. Team Organization Considerations

The selection of team members should consider the unique attributes of each team member as well as their composite attributes and dynamic. Although each individual brings to the team a unique set of skills, experience, knowledge, and intellect, the team leader must compose the team considering the characteristics of the whole team. The team should exhibit diversity, expertise, skills, balance, and positive chemistry.

The quality of personnel is the strongest factor within the successful project management equation. Even though a methodology may be considered superior to another; a group of interacting people is responsible for its implementation. A motivated team executing an average or basic methodology will generally outperform an unmotivated team executing a supposedly superior or more sophisticated methodology.[24] This rule of thumb is valid for most situations with the rare exception being when the particular situation explicitly calls for an element or technique exclusively found in one only methodology. A methodology (like planning using MDMP or Design) can assist a team perform at its best, but it cannot make a substandard team good. Professionals are knowledgeable in multiple methodologies and techniques and easily shift from one to another, mix, abbreviate, and sequence them to provide in essence a onetime tailored methodology best suited for the problem, the team, time, and resources at hand. The mark of a competent professional is their ability to assess a situation, adapt their methods, and exploit their strengths to effectively and efficiently accomplish their task.

There is an artful aspect of composing the Design team. The team leader must factor together the contributions of each individual with their ability to work with the other members cooperatively. The collective team capability has to be matched and address the particular nature of the situation, time available, and even the likely solution if it presents itself. The roles of the methodology have to be filled and the size of the team maintained at a reasonable level. The team member's background, experience, and skills should be as broad and deep as feasible.

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[24] Giovanni Asproni, Motivation, Teamwork, and Agile Development, *Agile Times*. (February 2004), http://www.giovanniasproni.com/articles/MotivationTeamworkAndAgileDevelopment.pdf (accessed March 11, 2009). My personal military and project management experience is consistent with these same insights made by Asproni.

The Team Leader (i.e. Chief of Plans) does not really have much flexibility in assessing the individual Plans Officers, in that this typically done within the wholesale Army and installation human resource management system. An enterprising Chief of Plans may be able to influence some of his section's assignment decisions but is does not have a significant degree of control. However, the Chief of Plans should have complete selection authority given this pool. He can use this authority to hand select the most qualified and appropriate participants.

Team selection should stress heterogeneity. Heterogeneous groups provide the team a broad knowledge and skill base than a homogeneous one (see Figure 6. Team Diversity**).** The addition of functional area plans officers from the same unit provides a small degree of homogeneity. Team members from outside the headquarters provide the team leader the best opportunity to find the desired variety of knowledge, background, and experience. These attributes contribute the critical component of diversity to the Design. Homogeneous groups add some capacity but provide little else.

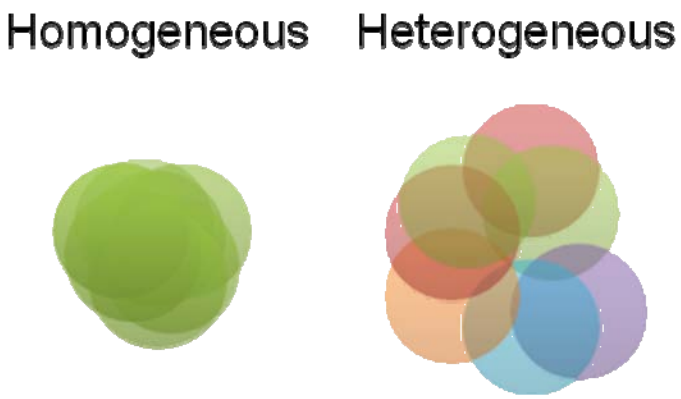

Figure 6. Team Diversity

A diverse or heterogeneous group can best assess the complexities of the situation and formulate strategies for effective unified action. By definition, a diverse

group is composed of individuals with different characteristics. A diverse or heterogeneous group would assemble a broader set of experiences, skills, and knowledge than a homogeneous group. A diverse group once formed can be more insightful, creative, and introspective. A diverse group is more likely to have deeper levels of individual capability in a greater number of specialized areas. A diverse group can best envision the spectrum and orchestration of feasible "whole of government" actions. A small diverse groups efficiency is achieved by the combination of a broad set of individual capabilities that homogeneous group and still be able to effectively address a complex situation.[25]

The Design team is built from various sources (see Figure 7). Although not required, the first choice to compose the team's core should be the strategic planners from the G5 section. They are best suited to compose the team by education, doctrinal responsibility, and experience. These planners have the specific education qualifying them to lead and support a larger planning or design team. These staff positions are directly responsible for unit planning to include leading staff planning. In addition, the strategic planners from the G5 sections are likely to be experience in both the general conduct of design as well as having worked as a team in prior exercises or operations. This group provides a solid base to build the larger team upon. The core group provides the trained and educated foundation for the team supporting the commander. For example, the core team can be composed of the Chief of Plans and a few of the Strategic Plans Officers (specialty skill designator 6S) assigned to the G5 Section. In a Division G5 cell this core team could include the Division Plans Officer (O5-02A6S), the Assistant Division Plans Officer (O4-02A6S), Fires Plans Officer (O4-02A6S), and the Sustainment Plans Officer (O4-

[25] Scott E Page and Lu Hong, *Diversity Trumps Ability*, (Edited by William J Baumol, Proceedings of the National Academy of Sciences, November 16, 2004), http://www.cscs.umich.edu/~spage/pnas.pdf (accessed March 11, 2009).

02A6S). The Design Team base composition could include the Commander, Chief of Plans, and two Functional Area Plans Officers (i.e. Operations, Intelligence) with one of the functional area plans officer functioning in the role of Scribe. Additional Design Team members could then be added based upon the unique nature of the situation, cooperation status, and personal availability. Other plans officers within the unit may be added as the situation warrants (e.g. sustainment, fires, and protection plans officers). Additional Design Team Members may be integrated from cooperating stakeholder organizations e.g. Joint, Interagency, Intergovernmental, Multinational, and for some operations NGOs and PVOs.

Alternatively, if the core is resourced from persons other than the G5 Section then additional attention should be placed to ensure the alternates possess adequate knowledge and experience. Selection of the team leader is of primary importance. Additional training may be warranted to orient them to necessary Design techniques and tools prior to the assembly of the full team. Exercises may provide utility to facilitate team building.

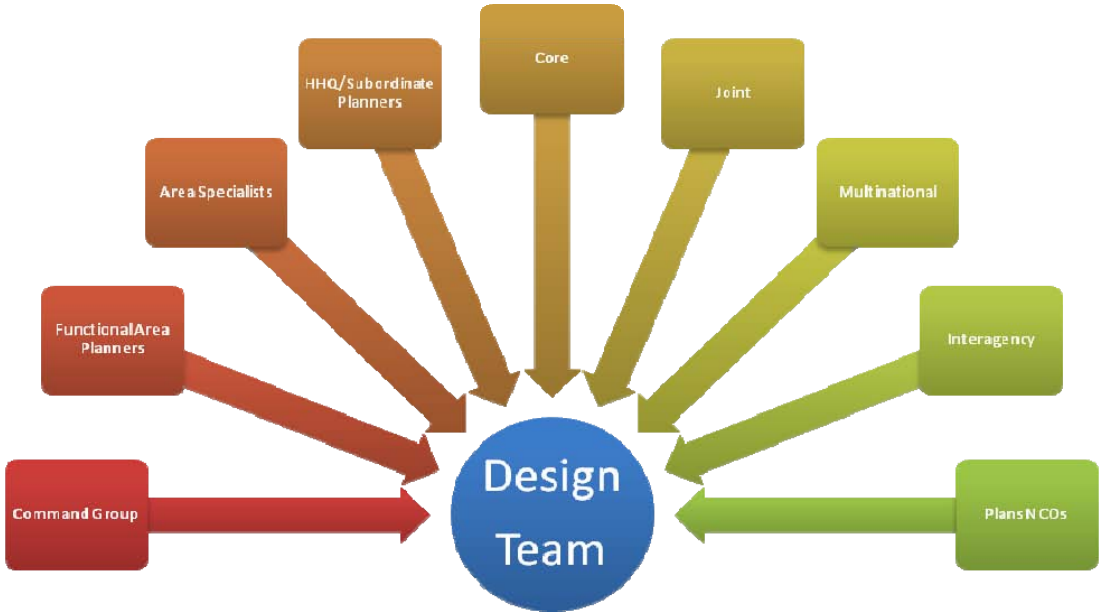

Figure 7. Design Team Member Candidates.

The team member can come from a number of sources internal and external to the command. As mentioned earlier, the team development begins with the identification of the core. The core is then augmented to meet the needs of the situation, group learning, and diversity. The team can be augmented by plans officers or functional area experts from within the command without complication. The next and perhaps the most important source for team members are temporary augmentations from external organizations. External sources are a source for external perspectives and capability expertise not found within the US Army (e.g. political and economic expertise) as well as regional expertise. The inclusion of regional expertise within the team should be one of the Team Leaders recruitment priorities. External sources are also important in that they may directly provide stakeholders perspectives. For example, a planner from a subordinate force has better knowledge of his own forces capabilities and limitations than an outsider. The value of integrating a subordinate force planner into the team is doubly important is the subordinate force is of a different nature or heterogeneous e.g. Joint, Interagency, Intergovernmental, or Multinational. A planner from another force would function in the team temporarily as both Designer and Liaison Officer (LNO). Another example would be a stakeholder from the affected local or regional area. A local stakeholder is going to have a much more intimate understanding of the system undergoing analysis. Although not exhaustive, the potential candidate sources could come from the following sources:

- Core
    - Chief of Plans
    - Strategic Plans Officers (i.e. combat arms, fires, and sustainment)
- Command Group
    - Commander
    - Chief of Staff or Executive Officer
    - Assistant or Deputy Commanders
    - Primary or Special Staff

- Functional Area Planners
- Area Specialists
    - Department of State Foreign Service Officers
    - Foreign Area Officers
    - Country Team
    - Human Terrain Team
    - Defense Intelligence Agency (DIA)
    - Regional focused Military Intelligence (MI) Brigade (BDE)
    - Department of Defense and Army threat analysts (e.g. TRADOC G2, Foreign Military Studies Office, Combat Studies Institute)
    - Academics
    - Federally Funded Research and Development Corporations (FFRDC) (e.g. Rand Corp, Institute for Defense Analysis, Mitre Corp)
    - Private Think Tanks
    - Non Governmental Organizations
    - Private Voluntary Organizations
    - International or Local Business Leaders
    - Regional or Local Leaders

- Partner Planners or Liaisons
    - Higher headquarters
    - Subordinate headquarters

- Joint Planners or Liaisons
    - US Marine Corps
    - US Air Force
    - US Navy
    - Special Operations Forces

- Multinational Planners or Liaisons
    - North Atlantic Treaty Organization (NATO)
    - Unite Nations (UN)
    - Coalition
    - Bilateral Allies
    - Regional or Local Security Force

- Interagency Planners or Liaisons
    - Department of State (DoS)
    - US Agency for International Development (USAID)
    - Department of Commerce (DoC)
    - Department of Homeland Security (DHS)
    - Department of Justice (DoJ)
    - Central Intelligence Agency (CIA)
    - Federal Bureau of Investigation (FBI)

- G5 Section Plans Noncommissioned Officers

Additional, members are added to the team's core membership to provide both the necessary diversity and unique knowledge or experience in character with the nature of the situation under design scrutiny. It is in this selection that the team leader has the most opportunity. Internal to the Plans Section, the team is likely to have dedicated staff officers with technical planning proficiency in the following areas:

- Combat Arms
- Joint Operations Planning and Execution System (JOPES)
- Force Modernization
- Movement and Maneuver
- Aviation
- Information Engagement
- Civil Engineer
- Intelligence
- Protection
- Civil Affairs
- Special Technical Operations

The additional perspectives may be needed from the other sources. Plans Officers within the remainder of the headquarters can be used to supplement the Plans Section if more military specialized knowledge or experience is needed. However, if the design case is that of an ill-structured and complex situation, some external expertise is very desirable if not required.

External expertise may be accessed from multiple sources. The design may need the expertise of Joint or Multi-national officers. The design may need the expertise to support "whole of government" approaches e.g. Department of State, Department of Commerce. The design almost certainly will need regional or situational expertise with knowledge of or experience within the system under review.[26]

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[26] Richard H. Shultz, Jr., *In the Aftermath of War: US Support for Reconstruction and Nation-Building in Panama Following Just Cause*, (Study, Maxwell Air Base, AL: Air University Press, 1993), 18.

Internally resourced team members have certain advantages and disadvantages. Obviously, access to internal unit augmentations will be more easily and expeditiously coordinated. Internal resourced team members are more easily integrated within the team due to common knowledge, experiences, and cultural. Being from the same organization, the members have the same mission and likely the same loyalties and motivations. Internally, resourced team members are likely to have had personal experience with one another and with the unit Standing Operating Procedures (SOP); and in some cases have participated in other Design activities with the core team. All of these attributes seem to favor their use. However, the disadvantage in their use is the lack of diversity within the team. If the team is generally homogeneous then the addition of each additional member only makes a small change in the teams overall knowledge and experience base at the cost of team size bloat.

The importance of the active participation of the commander within Design cannot be overstressed. However, it is accepted that the commander's level of participation is a command prerogative. The commander can choose between three modes of interaction with the Design Team. The modes are (in order of preference): 1. full time, 2. part time, or 3. iteration/phase review only. If the Commander chooses to participate full time, then another member of the Command Group can be identified to provide a critical review from an outside perspective. The Chief of Plans leads the team in the absence of the commander. If the commander is unable to perform the role of Design Team Leader then a senior leader of the unit (e.g. chief of staff, assistant commander, or G3 operations officer) may participate as his representative. The mode of participation or use of a representative should be made at the initiation of design activities in order to increase the effectiveness of team discourse. A change in team membership is disruptive to the team dynamic and team learning.

A mature team will perform more effectively and efficiently. The team's common understanding of each other's skills, background, disposition, experience, manners, personality, philosophy, strengths, and weaknesses all combine to reduce friction and in turn permits the team to synergistically complement and compensate with one another. In most cases, a mature team with this level of team knowledge has spent weeks or months together and has either conducted multiple design sessions or has participated in other bonding and integrating experience.

In addition, selection should consider chemistry as well as diversity, although to a degree, the team leader has to work with the team he or she has. The team leader is also likely to have some degree of control over internal selection and team size. The team leader may not be able to assemble a "dream team" but normally can normally exclude a known non-contributor or troublemaker.

If the individuals have personal animosity or are too competitive the team performance will suffer. It should be noted that some contrarian behavior is required as part of the group discourse and critical thinking. This is why it is important to select team members that have the maturity to professionally disagree and work an ambiguous or complex issue to ground. In training some bad chemistry may be tolerated and the interpersonal issues may resolve themselves through interaction. In a time of crisis, if the team leader knows of a significant interpersonal issue between two candidates it may be wiser to simply avoid the conflict.

Addition of new team members, or even exclusion of existing team members, is not warranted in all circumstances. A practiced team may be more effective than a new team tailored for the situation. Changing the composition of an existing team will initiate a new group accommodation process. Existing roles may be altered that will delay progress initially. The addition of new team members to an established team may initiate a variety of behaviors. The team leader must introduce new members to an existing team

judiciously; and manage the team dynamic to meld the new with the old. It stands as obvious that the new members will lack the knowledge of the other team members, the team's characteristic approaches and techniques, and naturally the common understanding developed via previous discourse. Depending upon the disposition and character of the members, the old team members may be cliquish and impatient. On the other hand, they may be inclusive and supportive. The team leader must be conscious of these possibilities and manage the team composition and dynamic accordingly.

Team organization is impacted by the commitment status of the unit, headquarters location, and time available. Internal and external personnel may be more or less available given the variety of circumstances, for example, if the unit is conducting pre-hostility contingency planning, or crisis action planning, or conducting in theater design to support a follow-on operation/phase. Given the variety of circumstances, it is likely that one of the team's challenges will be to assemble and maintain this group of high performers for the extended period of time necessary to conduct Design. The design activity sponsor is responsible for assembling the team. It behooves the Army Service Component Commands (ASCC), Combatant Commands (COCOM), and the Department of Defense (DoD) to anticipate these needs and to take steps to facilitate the rapid organization these teams. The anticipation of need is most necessary when seeking regional expertise outside of DoD.

Considerations for adaptation include command guidance, the initial impressions of the situation risks and challenges, the team's familiarity with situation, the team's makeup and capability, time available, and support environment available. The nature of the situation is one of the major factors. Its breadth and degree of complexity establishes the problem space. The team leader should seek designers that have the appropriate domain knowledge and experience to thoroughly investigate the situation. This assessment would include assessing the mesh of personalities. They should be able to

effectively and efficiently cooperate within the team context. The bottom line is that the quality (intellect, design skill, experience, maturity) of the designers in most cases is the most important factor. However, the reality of team composition is that the team leader is likely to have a mix of strong and weak/"problematic" individuals. Some are most likely to have never conducted design or have no experience with the other individuals on the team. The team leader will often be challenged to manage the team dynamic.

The selection of individuals for the team has other considerations as well. The individuals should have the necessary skills and experience to perform the various roles within the team. The team leader will have to assess these considerations against the size, expertise required, and the specific analysis method desired.

What are the Team Roles?

Roles within a design team facilitate team workflow and efficiency. Roles are identified to conduct specialized or uncommon tasks. Roles are assigned to an appropriately skilled personnel. The use of roles helps team work more smoothly by pre-determining a member that performs tasks that are not practical to be performed as a group activity. For example, a task to *Take Notes* is more efficiently performed by an individual than a group.

A *role* is an abstract worker whose performs a set of activities and works with applicable artifacts.[27] Roles are not individuals; instead, they describe how individuals behave in the business and what responsibilities these individuals have. Roles are typically realized by an individual, or a set of individuals. A role is temporary. They are not the equivalent to duty position or billet. One role may be assigned to multiple people; and one person may perform multiple roles. For example, two planners may be assigned

[27] Rational Software Corporation, *Rational Software Process (RUP),* 2001.

the role of Scribe; one team member may act as both Scribe and Discourse Leader for a small group breakout session or four plans officers may act as Designers. A team member can perform many different roles at different times. For example, the unit Commander may choose to perform the role of Team Leader or he may delegate it to the Chief of Plans while he attends to other business. Later he may rejoin the group but in the basic role of Designer.

A Design Team usually is not highly or formally structured, however some basic roles are useful to organize the work. A Design Team would be characterized as a short-life organization.[28] Design Team roles are established and defined casually and may change through the course of the design session as the team and team leader sees fit.

It is difficult to explicitly define the roles within a Design Team. Functional analysts of well understood operations commonly perform process decomposition and activity based costing analyses to determine the process optimization alternatives. This technique is currently less feasible in the case of Design. The factors that make this impractical are: 1. The design method activities are creative and not mechanistic, 2. The method activities are not standardized but are situation and team unique, 3. The method activities have not been doctrinally defined, and 4. The method is iterative with no defined number of iterations. In combination, these factors challenge analysis at this time.

Although a classic activity analysis is not necessarily called for, a general understanding of the functional activities is still necessary to frame the analysis of other aspects of the methodology. For the analysis of roles we will extrapolate from the higher level team activities identified earlier i.e. Prepare for Operations, Manage Information, Assess Situation, Develop Strategies, and Collaborate. The figure below illustrates the

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[28] Herbert G. Hicks and C. Ray Gullet, *The Management of Organizations*, (New York, McGraw-Hill, 1976).

primary activities conducted by the team within the Design methodology and their gross relationships (see Figure 8. Design Activities).

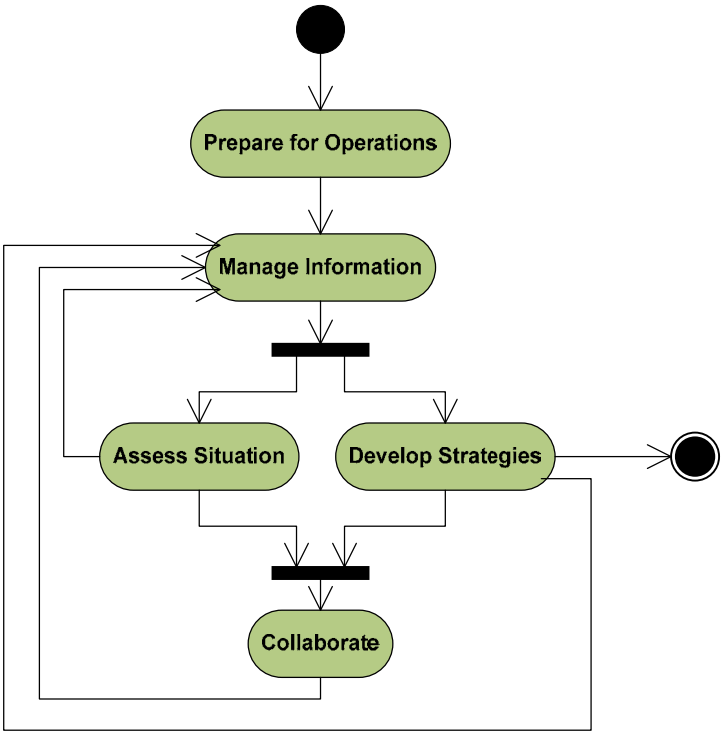

Figure 8. Design Activities

The following paragraphs will identify a set of general roles in support of each Design Team activities. When analyzing Design activities for role creation purposes you search for: unique tasks for one person, value chain steps, artifact state change, decision points, unique skills, and unique characteristics. The description of role tasks provided within these paragraphs should be sufficient to understand the nature and scope of the role and should not be mistaken for a full task analysis. The Design Team roles are mutable—they may be combined or specialized given the needs and constraints of the scenario. The roles synthesized from process analysis and used within my personal experience are: Designer, Designer (LNO), Subject Matter Expert (SME), Discourse Leader, Team Leader, Scribe, and Senior Leader (see Figure 9. Design Team

Organization). The Designer (LNO) is either a planner or Liaison Officer of unified action partner that performs the role of Designer. The availability of a planner is more likely and extremely valuable prior to the commencement of operations. After commencement the availability of the planners will likely decrease and the LNOs will have to be relied upon to support reframing activities. For the purposes of this role description a Subject Matter Expert (SME) is not a full time participant but rather a part time participant that provides input and/or insight. If full time participation is available then they would be characterized as a Designer.

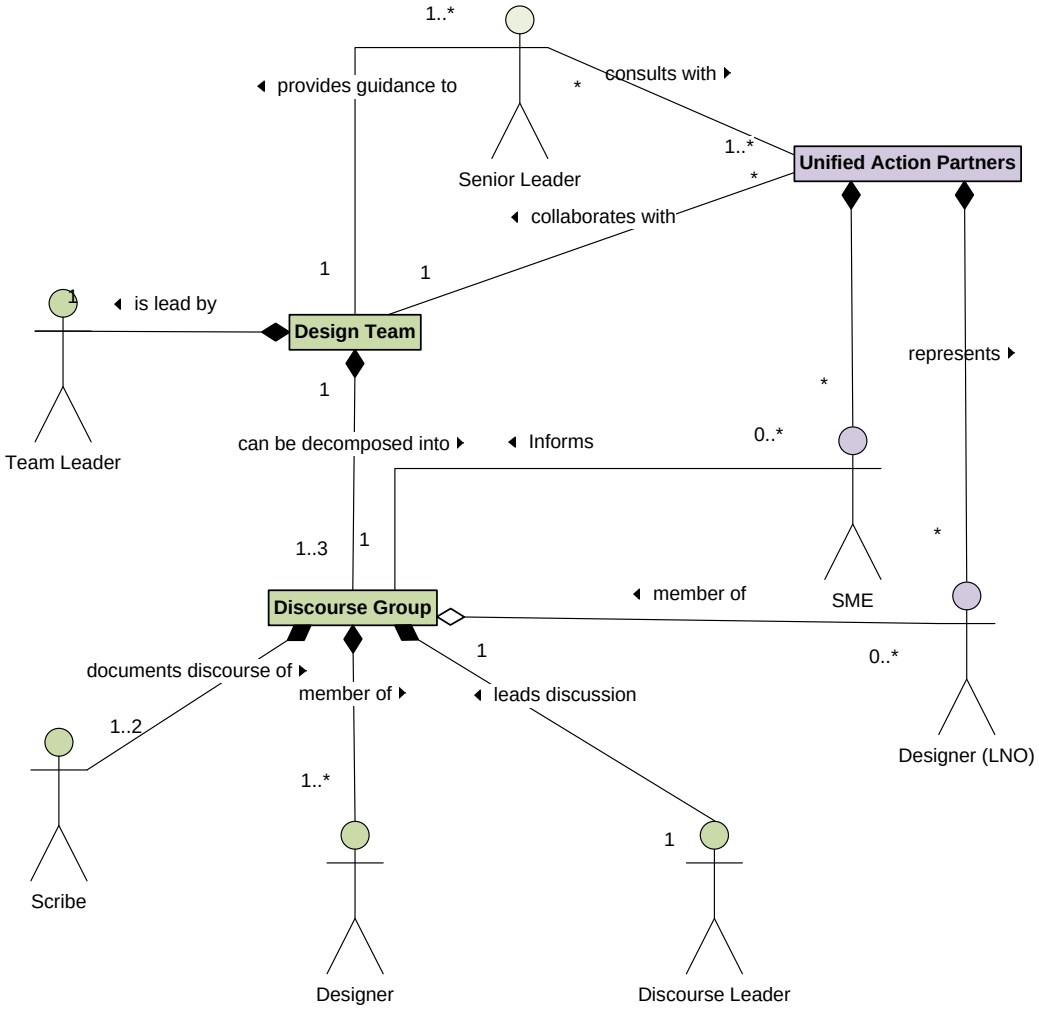

Figure 9. Design Team Organization

Some of the roles inherit characteristics (or attributes) and capabilities (or operations) from other roles (see Figure 10. Role Map).[29] Several of the roles are specialized from another as a base class. For example, the Scribe is also a Designer; and likewise the Team Leader is also a Discourse Leader. More descriptive role responsibility description is found later within this section. There are other roles that, while not part of the Design Team, interact with it during the course of their activities, to include: other unit staff (e.g. unit system administrator, unit knowledge manager), external stakeholders (e.g. other unit planners/designers).

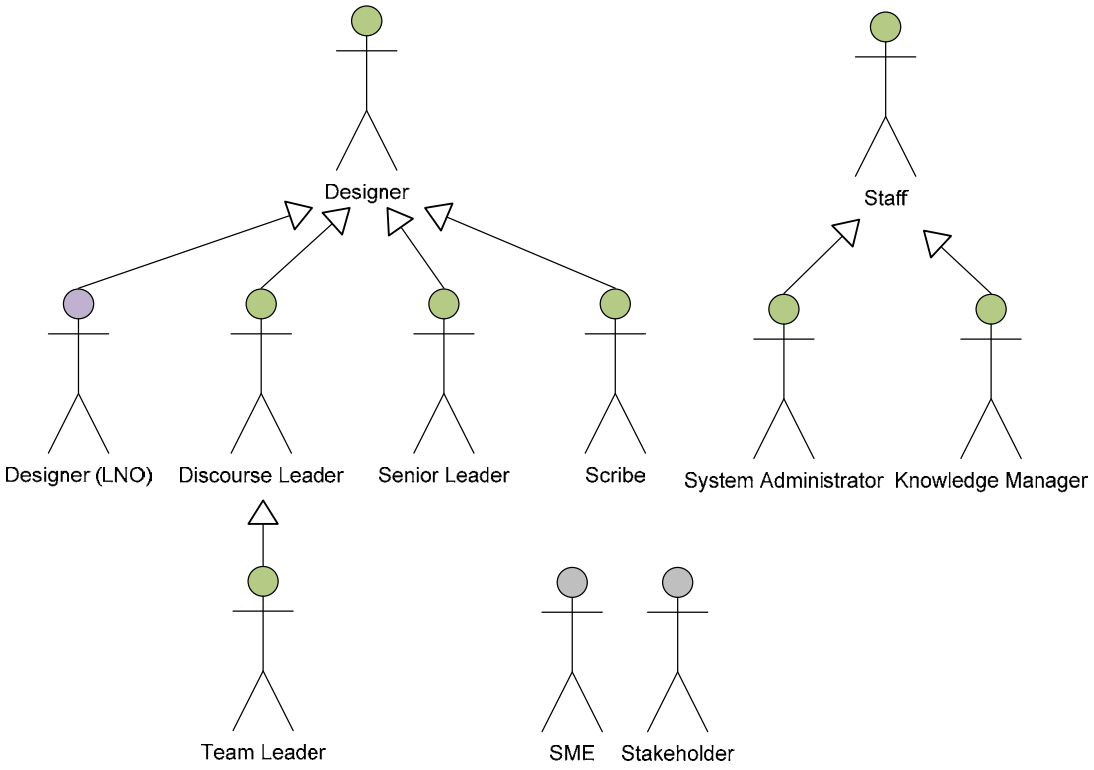

Figure 10. Role Map

[29] The arrows within Figure 9 Role Map are specific UML relationships—i.e. Generalization Relationships. The Role Map is not an organization chart; nor do the arrows represent any workflow. A generalization relationship between roles is shown by a generalization arrow, i.e. a solid line with a closed, hollow arrow head pointing at the parent role. A generalization from one role (A) to another role (B) indicates that A is a specialization of B. It may help if you think of the graphic relationship as a sentence. It should read in this manner—"A is a type of B".

The team activity *Prepare for Operations* utilizes three basic roles. Someone initiates the activity (i.e. the Senior Leader) and provides applicable guidance.[30] In turn, someone begins to organize the team and work (i.e. the Team Leader). And last but not least someone needs to start preparing the infrastructure for operations (i.e. the Scribe) in coordination with the unit System Administrator. In an alternative flow not shown, a Designer (LNO) may facilitate coordination of design activities with their parent organization.

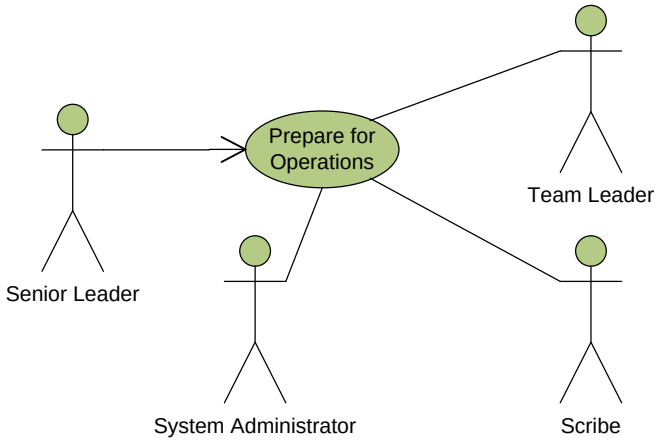

Figure 11. Use Case: Prepare for Operations

[30] Headquarters, United States Army Training and Doctrine Command, *TRADOC Pamphlet 525-5-500 Commander's Appreciation and Campaign Design*, Version 1.0, (Fort Monroe, VA: Department of the Army, 2008), 21.

The team activity *Manage Information* utilizes four basic roles (see Figure 12. Use Case: Manage Information). The Designers (of all persuasion and specialization) and SME collect relevant information and with the assistance of the Scribe and unit Knowledge Manager organize it for use.[31] This activity benefits significantly from information technology (IT) support.

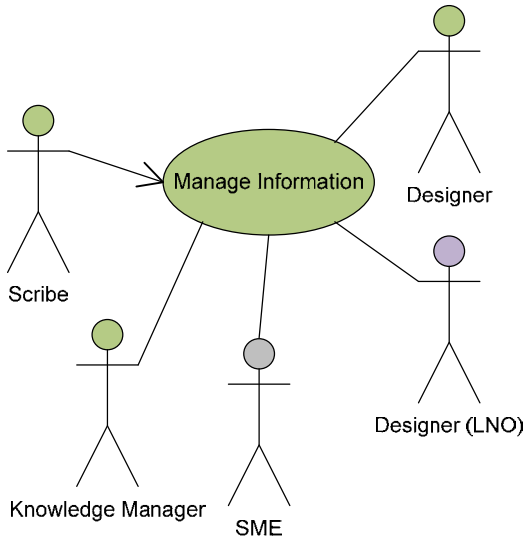

Figure 12. Use Case: Manage Information

[31] Headquarters, U.S. Department of the Army, *FM 6-0 Mission Command: Command and Control of Army Forces*, (Washington, D.C.:, 2005), 5-16.

The team activity *Assess Situation* utilizes four basic roles (see Figure 13. Use Case: Assess Situation.). The Discourse Leader facilitates group learning and critical thinking as they relate to understanding the system (i.e. environmental framing and problem framing) under review. The Designers contribute to the analytic discourse along with the scribe who captures the synthesized understanding of the system along with additional information that contributes to either understanding or corroboration of the understanding.[32] The Designers (LNO) contribute their unique knowledge and perspectives during this discourse.

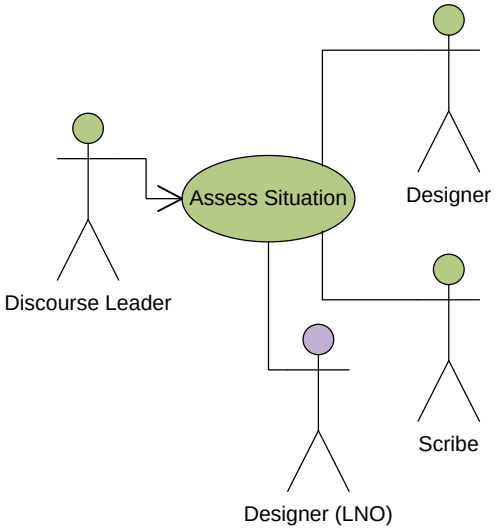

Figure 13. Use Case: Assess Situation.

[32] Headquarters, United States Army Training and Doctrine Command, *TRADOC Pamphlet 525-5-500 Commander's Appreciation and Campaign Design*, Version 1.0, (Fort Monroe, VA: Department of the Army, 2008), 21-26.

The team activity *Develop Strategies* utilizes four basic roles (see Figure 14. Use Case: Develop Strategies). The Discourse Leader facilitates group learning and critical thinking as they relate to the development of strategies for action (e.g. operational framing, mission analysis, campaign design, and campaign planning). The Designers contribute to the analytic discourse along with the scribe who captures the relevant strategies (e.g. theories of action, strategy narratives, problem frame map, and campaign directives) along with the information needs that contributes to measuring progress or effectiveness in execution.[33] The Designers (LNO) contribute their unique knowledge and perspectives during this discourse.

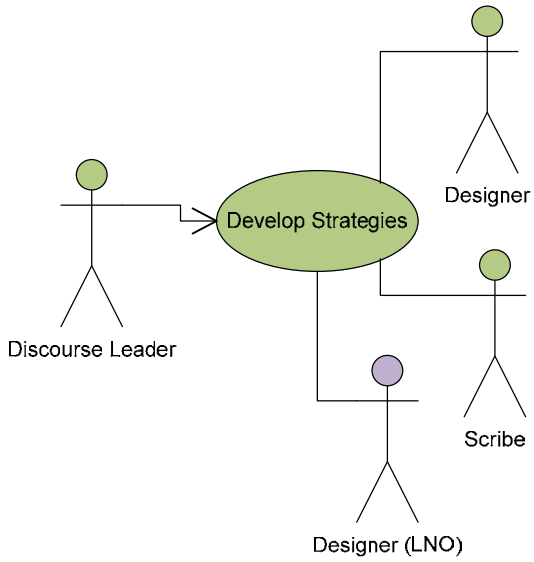

Figure 14. Use Case: Develop Strategies

[33] Headquarters, United States Army Training and Doctrine Command, *TRADOC Pamphlet 525-5-500 Commander's Appreciation and Campaign Design*, Version 1.0, (Fort Monroe, VA: Department of the Army, 2008), 26-32.

The team activity *Collaborate* utilizes five basic roles (see Figure 15. Use Case: Collaborate). The Discourse Leader facilitates an information exchange between the Discourse Group and external parties (e.g. SMEs or Stakeholders from cooperating organizations planners groups).[34] This case can be conducted in support of any other case and can range from the receipt of strategic guidance, to the exchange of very narrow domain information from a subject matter expert, to the development of a coalition campaign strategy. The Designers of all persuasions assist the Discourse Leader in the exchange of ideas and information with the external parties. This is the only activity in which the participants are not typically collocated. This activity benefits significantly from information technology (IT) support and in some cases is only possible with it. The Scribe operates the enabling collaboration information technologies, accesses and presents relevant information, and documents the exchange. In an alternative flow not shown, when given a precondition that the collaboration is either sensitive or is preliminary to a support commitment, the Team Leader or Senior Leader may participate.

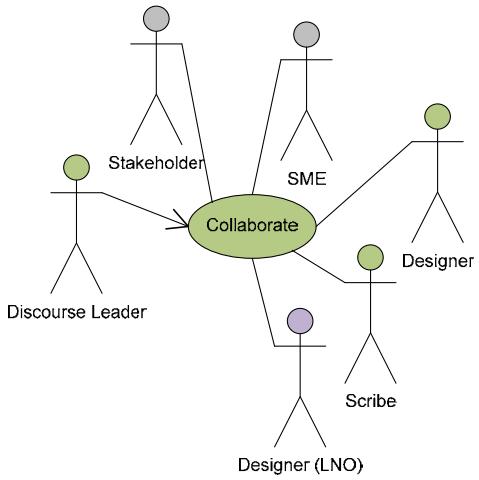

Figure 15. Use Case: Collaborate

[34] Headquarters, United States Army Training and Doctrine Command, *TRADOC Pamphlet 525-5-500 Commander's Appreciation and Campaign Design*, Version 1.0, (Fort Monroe, VA: Department of the Army, 2008), 24.

In summary, the role responsibilities within the Design team are:

- Designer
    - Researches situation by collecting relevant information from reference sources and directly from knowledgeable external parties and with the assistance of the Scribe and unit Knowledge Manager organize it for use
    - Assesses situation, to include contributing to the analytic discourse to develop understanding
    - Develops strategies for action, to include contributing to the analytic discourse involved in their generation and evaluation
    - Identifies information needs that contributes to measuring progress or effectiveness in execution

- Discourse Leader
    - Leads discourse group
    - Organizes activities and analysis,
    - Facilitates critical thinking and group learning
    - Includes Designer responsibilities

- Team Leader
    - Leads Design activities
    - Coordinates with leadership external to team
    - Coordinates for external support
    - Includes Designer responsibilities
    - Includes Discourse Leader responsibilities

- Scribe
    - Assists Team Leader prepare infrastructure for Design activities
    - Uses information technology to organize and document Design analysis and discourse
    - Assists other team members utilize information technology supporting Design
    - Records guidance
    - Develops supporting graphics
    - Drafts design artifacts
    - Records text based artifacts e.g. narratives, theories, strategies, plans, and directives
    - Records graphic based artifacts e.g. System and Operational Maps or other relevant visuals
    - Records sources for findings
    - Records information needs
    - Records outstanding questions and issues
    - Captures perspectives from external parties during collaborations
    - Includes Designer responsibilities

- Designer (LNO)
    - Coordinates Design with parent organization
    - Provides Unit Specific Information and Perspective

- Includes Designer responsibilities

What Size Should the Team Be?

The time available to conduct the design activity is a team size constraint to both the minimum and upward size limits. It factors into the upward limit of designers on the team in that as the size of the team increases the number of coordination interactions increases significantly (see Figure 16. Team Size and Number of Intra-team Relationship Chart and Figure 17. Implications of Team Size (*size~interactions*)). Caplow's analysis of team size provides an illustrative method to calculate the interactions: the number of interactions (i) is equivalent to the number of team members squared (d^2) minus the number of team members (d) and the remainder is divided by two.[35]

$$i = \frac{d^2 - d}{2}$$

For example, the number of bilateral interactions within a team of six is fifteen (i.e. $d = 6 \therefore i = (6^2 - 6)/2 \therefore i = (6^2 – 6)/2 = (36 - 6)/2 = 30/2 = 15$) and within a team of sixteen is one hundred and twenty (i.e. $d = 16 \therefore i = (16^2 - 16)/2 = (256 - 16)/2 = 240/2 = 120$).

[35] Theodore Caplow, "Organization Size." *Administrative Science Quarterly* 1, no. 4 (March 1957): 491.

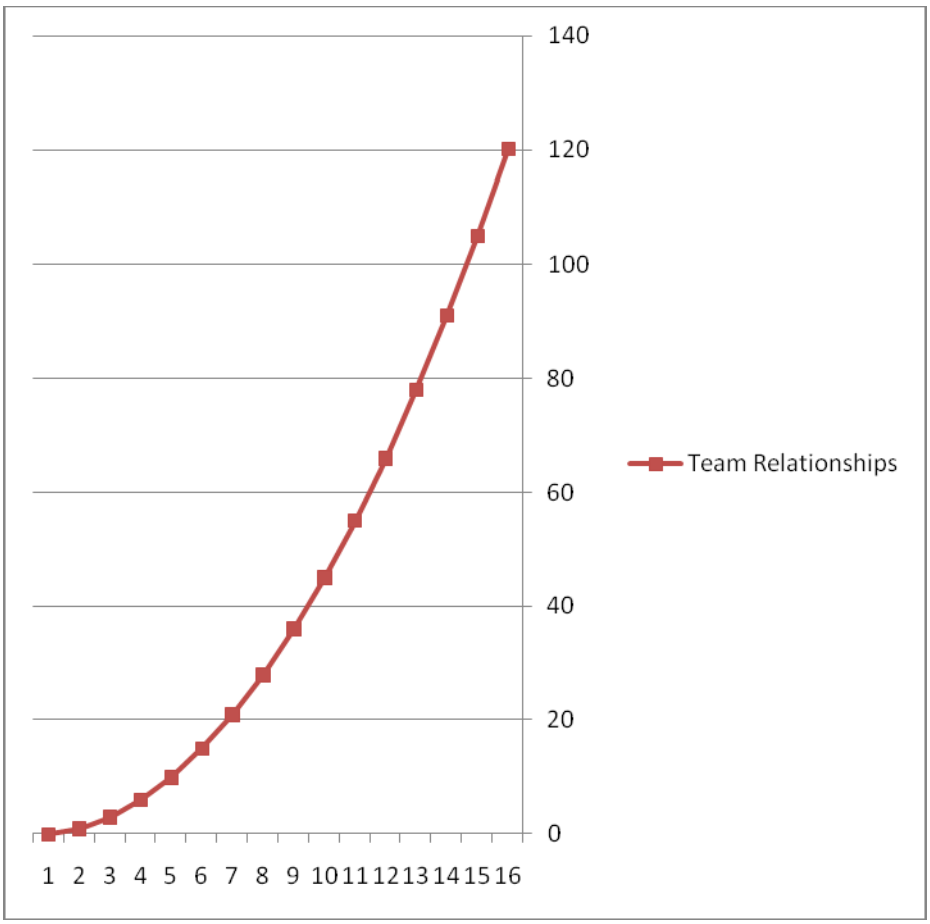

Figure 16. Team Size and Number of Intra-team Relationship Chart

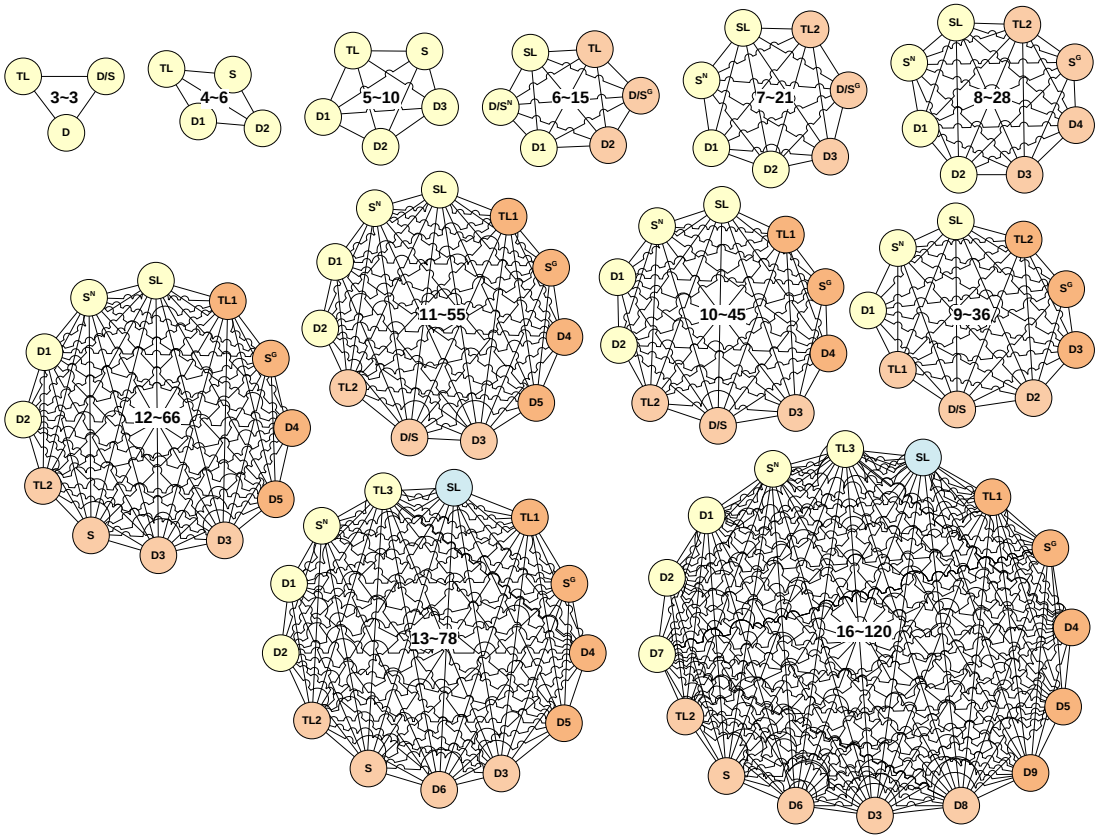

Figure 17. Implications of Team Size (*size~interactions*)

The minimum size for a Design Team is based upon the minimum number of individuals necessary to effectively conduct discourse. Studies indicate that the smallest number is three.[36] Effective discourse does not occur with less than three persons. With further increases in size the quality of the team product improves however the efficiency

[36] Lee Boh, Erin C. Hatch, Patrick R. Laughlin, and Jonathan S. Silver, "Groups Perform Better Than the Best Individuals on Letters-to-Numbers Problems: Effects of Group Size," *Journal of Personality & Social Psychology*, (2006): 644-651. This study analyzed small groups (i.e. one-five) performing complex problem solving. There was a significant improvement in performance when the group size was three or more. Although increasing the group size over three did not generate significant improvements in performance. Indicating that three is the optimum size for group problem solving of this particular type.

declines. Similarly, within groups of two, three, and four the larger groups are more effective, if other team composition factors are held constant.[37] Some feel that small groups are unstable and that team identity does not manifest in groups smaller than five.

> *In my experience the smallest viable group size seems to be somewhere in the range of 5 to 9. Looking smaller, we see that a group of 2 can be tremendously creative (ask any parent), but often has insufficient resources and thus requires deep commitment by both parties. Notably, often the difficulty of a 2-person business partnership is compared to that of a marriage. A group of 3 is often unstable, with one person feeling left out, or else one person controlling the others by being the "split" vote. A group of 4 often devolves into two pairs.*[38]

The team size is somewhat impacted by the need to perform necessary roles and is largely impacted by need to include individuals with the expertise consistent with the nature of the situation. Each team must have at least one but preferably two persons capable of performing the essential roles (leader, scribe, and designer). Redundancy of role capacity permits the team to operate in the temporary absence of the primary individual performing that role; and provides the team the flexibility to split into multiple subgroups for short periods of time.

The team leader should attempt to maintain the contribution by the members balanced. From a study that involved groups of varying size it was found that, the higher the size of the group, the more imbalanced the participation of the partners in the activity becomes.[39] Within groups on the high end of the range, it is likely that a small group of dominant individuals will tend to control the discourse. In these situations, discourse is

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[37] Nikolaos Avouris, Meletis Margaritis, and Vassilis Komis, "The effect of group size in synchronous collaborative problem solving activities," *Proceedings ED Media AACE Conf*, (Lugano: University of Patras, 2004), 4303.

[38] Chris Allen, "The Dunbar Number as a Limit to Group Sizes," *Life With Alacrity*, (March 2004), http://www.lifewithalacrity.com/2004/03/the_dunbar_numb.html (accessed March 11, 2009).

[39] Nikolaos Avouris, Meletis Margaritis, and Vassilis Komis, "The effect of group size in synchronous collaborative problem solving activities," *Proceedings ED Media AACE Conf*, (Lugano: University of Patras, 2004), 4306.

more likely to become polarized or emotional. Some less dominant personalities are likely to effectively withdraw from the discourse if they are not given adequate time to contribute. If they aren't engaged they are also likely to become bored, and in some cases resentful. Future participation by such persons is less likely as well and may cause dissention among the functional line mangers/staff area leaders.

The design team size could range from three to sixteen, with a team size of five to nine being optimum for most situations (see Figure 18. Recommended Team Size).[40] Experience at Unified Quest 2005 found that a team size of six to be an acceptable and workable number of participants and that too many members would have been unwieldy, and too few would not create the diversity of skills and opinions necessary to foster meaningful discourse.[41]

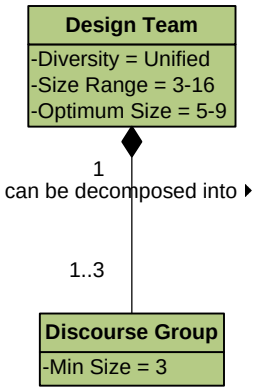

Figure 18. Recommended Team Size

[40] Chris Allen, "The Dunbar Number as a Limit to Group Sizes," *Life With Alacrity.* (March 2004), http://www.lifewithalacrity.com/2004/03/the_dunbar_numb.html (accessed March 11, 2009).

[41] LTC William T. Sorrells, LTC Glen R. Downing, MAJ Paul J. Blakesley, MAJ David W. Pendall, MAJ Jason K. Walk, and MAJ Richard D. Wallwork, *Systemic Operational Design: An Introduction,* (Monograph, School of Advanced Military Studies, Command and General Staff College, Fort Leavenworth: United States Army, 2005), 30-31.

The valued contribution of each additional team member must be factored against the geometric increases in time required for each member to learn and contribute, and for the team to synthesize the contribution. Each person potentially adds additional skills, knowledge, and experience; however, the addition of each additional person also contributes to an ever increasing information sharing and coordination burden. At a point in the equation adding more people becomes counterproductive to achieving team goals within a reasonable amount of time.

The size of the team is a factor e to be weighed by the team leader when composing the team. If the team's capability (e.g. skills, knowledge, experience, etc.) is held as a constant, a smaller team can perform more efficient than a large team. So in summary, the calculus in composing the Design Team is to fill the roles, include all necessary skills, knowledge, experience; in as small a team as possible considering the chemistry, personality, and accessibility of the team members, the nature of the situation, the likely solutions, and time available.

In the same way that form follows function, the supporting infrastructure has to support the organization performing the functions. Team size affects the requisite physical environment capacity and layout. The tasks performed by the various roles may have enabling technologies to improve the speed and quality of performance.

Design Team Support

Support to a Design Team improves the team's ability to produce quality designs in a timely manner. A team can conduct Design with minimal support if required. However, a modest degree of support can improve the performance of the team. Design team support has several areas for consideration and impacted by several situational factors.

The primary areas of support needed by a Design Team are: infrastructure, information technology (IT) or more specifically command and control information systems (C2IS), and information (see Figure 19. Design Team Support Areas). The infrastructure provides life support and a work environment. The C2IS provide tools to enable and facilitate the cognitive design activities. The C2IS also facilitate communications within the team and external to the team. Information is the raw input to Design that is provided to the team by external actors.

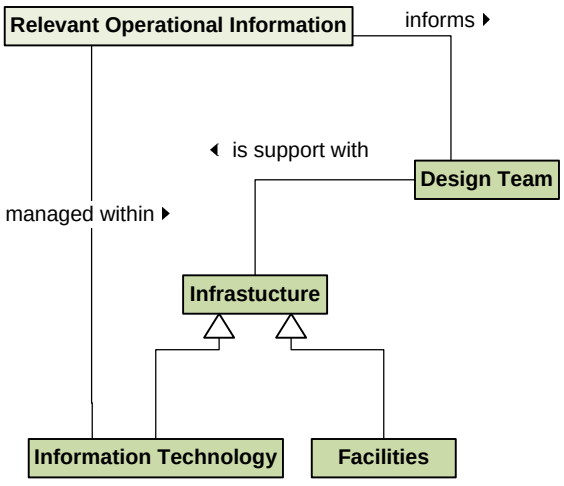

Figure 19. Design Team Support Areas

The supporting needs of the team are impacted by each team's Design Standing Operating Procedures (SOP), the situation under Design review, the headquarters

location, and assessed time available. The team's SOP may include techniques with unique environmental or C2IS needs. The situation may call for specialized analysis or for use of a very large team. The headquarters location drives the use of either home station/prepared fixed facilities, austere facilities, or mobile command post systems (e.g. Single Integrated Command Post System – SICPS). The time available may preclude or constrain some desirable support preparations (e.g. facility coordination, facility setup, C2IS initialization and data loading, information gathering, information organization).

As mentioned previously, the support needs are dependent upon the particular workflow and its artifact management needs of the methodology. At this stage in the Design process maturation, to inform the support needs, we are using the following high level activities: Prepare for Operation, Manage Information, Assess Situation, Develop Strategies, and Collaborate. The elemental artifacts are: Environmental Frame (narrative and graphic), Problem Frame (narrative and graphic), and the Design Concept (narrative and graphic).

What Infrastructure Does the Team Need?

Efficient Design activities require focused efforts. The active discourse inherent within the Design methodology requires the team to have dedicated and normally extended time periods within which to foster the necessary critical thinking and group learning. The team environment should be controlled and enhanced to provide this focus. Distractions should be eliminated and all steps available should be taken to facilitate the smooth and natural conduct of Design. The Design infrastructure is either a temporary addition or reconfiguration of the overall headquarters infrastructure. The Design activities should be temporarily segregated from other headquarters activities; and upon completion may be reconfigured to reintegrate the work areas per SOP.

The infrastructure provides those environmental enablers for the group to meet and facilitates both independent research, discourse, and design documentation. The design venue should facilitate the work of the full design team. The facilities therefore should be both scalable to various team sizes and permit various configurations of work (see Figure 20. Design Facilities). If the team is large (i.e. greater than ten) then the main work area should be augmented with one or two small group work areas. The main work area should be the priority for support. The main work area should support the concurrent activities of the entire team with a limited seating expansion capability to accommodate a few visitors or observers. Each team member should be able to transition from discourse to research or product development without reconfiguration. Each team member should be able to see all other members and common format displays (e.g. large screen displays, whiteboards, and butcher-paper easels).

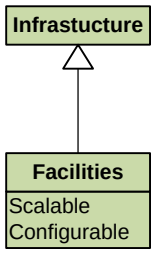

Figure 20. Design Facilities

The need to support face-to-face communications, eliminates the use of rows as a configuration, and therefore requires that some form of a closed or open, and inward facing seating configuration be used. Although a standard room seating configuration is envisioned, desks and chairs should be able to be rearranged easily to reflect the nature and organization of work. The venue should accommodate one, and preferably two, large screen displays and at least one whiteboard. The venue should be able to support unclassified and classified activities up to Top Secret. Life support capabilities (i.e. power, climate control, mobility, storage, health, and sustainment) should be

commensurate with the standard command post configuration and capability. The additional small group work areas should be adjacent to the main work area. The small group areas should support a concentrated group work effort lasting a few hours. An example of use would be for a subgroup to breakout for a categorical discourse or to draft a single *strawman* product. The small group areas should provide a large screen display, map board, and a white board.

What Command and Control Information System Support is Needed?

There are opportunities for information technology to expedite the development of quality operational plans. Very little information technology is specifically developed to support planning and none has been developed specifically with Design in mind. Generally, information technology within our headquarters facilitates the management of tactical information, production of design artifacts, and provides computational support in several narrow niches (see Figure 21. Information Technology Support). The information technology support should be secure and usable with little additional training. Due to the many ways to conduct Design tasks the software should exhibit a high degree of flexibility (i.e. the software should support and not constrain the Designers analysis). Some IT needs can be met with current systems, others require the application of available but not fielded capabilities, and others would require additional research and development.

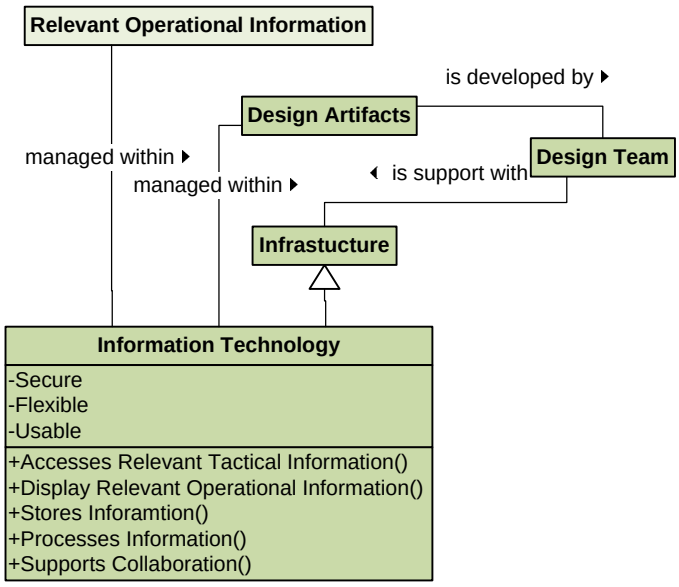

Figure 21. Information Technology Support

Our expectations for information technology to have a major impact on Design must be tempered. Some argue that information technology is revolutionizing the U.S. Army's Battle Command methodology.[42] There is opportunity for revolution; however, the actual pace of change is much closer to evolution.[43] The idea that information technology is going to revolutionize Battle Command is theoretically valid but not practically feasible. Current information technologies do provide significant and measurable improvements in the speed of data exchange, storage, and display; which should not be miscounted. However, surprisingly very little of our computer power is actually applied to military information processing. We have been successful providing basic capabilities to most functions but the development of truly sophisticated software in most areas has not been accomplished. Most systems are used as simple input/output and information exchange devices with little domain computation. Some systems provide extraordinary capabilities in support of narrow functions that can be structured for computation. Most others still provide support basic tools to human functions i.e. the humans are doing the thinking--the computers are mainly input/output and transmission devices. Information technology can be effectively applied to Design in a variety of ways and levels but leaders should expect that development of advanced capabilities will take considerable time and effort.

The Design C2IS context of operation includes the aforementioned infrastructure, the users, the C2IS of the unit, and the external IT accessed. The infrastructure provides the C2IS with commercial power, protection from the elements, and integrated user work

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[42] David S. Alberts, *Information Age Transformation: Getting to a 21st Century Military*, (Washington, DC: Department of Defense Command and Control Research Program, 2002), 49.

[43] James R. Blaker, *Transforming Military Force: The Legacy of Arthur Cebrowski and Network Centric Warfare*, (Westport, Connecticut: Praeger Security International, 2007), 15, 144, 222.

surfaces. The users have basic C2IS training, although the Scribes should be considered advanced users. It is not envisioned that visiting SMEs or other visitors require access to Design C2IS, although network access would be useful so that they may access information to provide the team. The users are generally collocated within either a multilevel secure local area network (LAN) or multiple LANs commensurate with the various network security levels. The users may relocate to another nearby facility or meeting room which necessitates either PCs workstation carts or preferably Laptop computers. The LAN must support the nearby meeting rooms via cable/wired LANs or wireless LANs. The unit C2IS set shall provide interfaces with the other Army Battle Command System (ABCS) within the unit, server, and communications support to the Design C2IS per unit Standing Operating Procedure.

User Needs

A Design Team's Command and Control Information System (C2IS) support is primarily met using existing capabilities. Most headquarters have adequate force level Command and Control (C2) systems and general purpose information technology to provide the basic needs of the Design Team. The C2 systems are provided via formal equipment authorizations and Battle Command system fielding. US Army headquarters at echelons above brigade possess adequate numbers of Army Battle Command Systems (e.g. Command Post of the Future, Maneuver Control System, Distributed Common Ground System, Global Command and Control System) to support the Design Team's military analysis. These systems are augmented by additional unit level purchases of commercial IT. Commercial Off The Shelf (COTS) hardware (e.g. personal computers, organization servers) and software (e.g. MS Windows operating system, MS office applications) are adequate to facilitate many simple tasks that do not require content specialization. Communications are available to support high bandwidth exchanges and

collaboration at both the classified and unclassified levels with US Army planning partners and to a lesser degree with US joint force planning partners. Cumulatively, the existing headquarters information technology infrastructure provides most of the core and necessary capabilities needed by the Design Team. However, although the basic needs are supported, Design Team activities are not optimized in any way and could be greatly improved with a modest degree of unit automation and TRADOC combat development attention. In addition, there are security policy issues that should be addressed when the Design Team includes personnel not associated with the headquarters.

Although sophisticated information processing capabilities can be envisioned to support Design in the conduct of situational analysis or operational effects projection, there are some technologies that if included within the Design Team IT support package provide considerable benefit with modest and low risk investment. These technologies include those that accelerate the capture, organization, and flexible display of information. These technologies would strive to allow the humans to focus upon the complexity of the system under review. This allows the humans to do what they do best (and in some cases have the sole capacity to do) and complement that capacity with those things the computers do well. This idea is consistent with the C2 Design Tenets—*Automate the Routine.*[44] Meanwhile, US Army and Department of Defense research and development may be conducted to isolate the tangible aspects of applicable Design theories that may be quantified and standardized to the degree necessary to support computer processing. These tangible aspects can be provisioned within future analytic or forecasting applications when understood.

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[44] TRADOC Program Integration Office - Battle Command, *Battle Command Information System Migration and Integration Plan,* v 1.7.2. (Washington, D.C.: US Army G3/5/7, 2005).

The Design Teams needs information technology to provide a number of services. The team environment should include knowledge and information management capabilities and access tools to conduct research, visualize the system and operation, and to capture the associated narrative. The Design C2IS should expedite data access/retrieval and facilitate its organization. It should also facilitate teams' learning and knowledge management by supporting the capture and conversion information. The Design C2IS should facilitate information exchange and discourse with SMEs and other planners/designers that are not collocated. Lastly it should facilitate production and manipulation of team knowledge into products supporting decision making and further planning. Additional details regarding the functionality, usability, performance, security, and necessary interfaces are provided in the following paragraphs.

Functionality

The system use cases are derived from the Design Team activities. These use cases represent the system user interactions supporting the Design activities. They, along with the derived relationships, are illustrated in Figure 22. Design C2IS System Use Cases. The itemized list of Design C2IS system use cases are:

- Initialize
- Load Operational Data
- Protect
- Collect COP
- Collect Execution Information
- Store Relevant Information
- Process Relevant Information
- Display Relevant Information
- Disseminate COP
- Disseminates Execution Information
- Support Situational Assessment Development
- Support Strategy Development
- Support Narrative Development

- Support Graphic Development
- Support Collaboration[45]

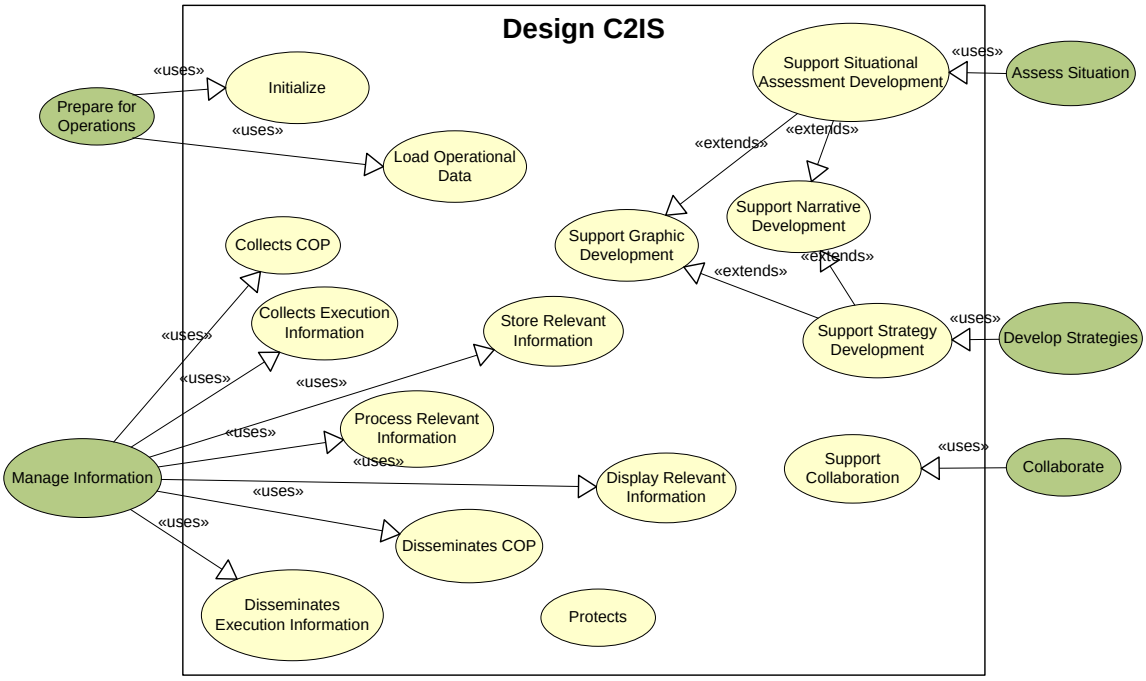

Figure 22. Design C2IS System Use Cases

The use cases are a rich source for additional analysis and information system prototyping, within these use cases the emerging capabilities are:

- The Design C2IS shall initialize and load data from authoritative sources.
- The Design C2IS shall access situational information in structured and unstructured form in order to develop understanding
- The Design C2IS shall provide means to organize textual information to support both categorical and relational analysis.

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[45] Headquarters, U.S. Department of the Army, *FM 6-0 Mission Command: Command and Control of Army Forces,* (Washington, D.C.: 2005), 3-15. Collaboration involves real-time or near real-time audio and visual communications. At higher echelons it may include video teleconferences and white-boarding. At lower echelons it may involve only radio conversations and meetings. Collaboration can serve to discuss the COP, update IRs, generate knowledge, improve the commander's visualization, share situational understanding, and improve decisionmaking. Collaboration disseminates knowledge and improves situational understanding, both horizontally and vertically.

- The Design C2IS shall provide means to organize structured, unstructured data and multimedia to support analysis.
- The Design C2IS shall provide means to develop and manage graphical models of system.
- The Design C2IS shall provide means to develop and manage textual products characterizing various aspects of design.
- The Design C2IS shall record audio.[46] Rationale: to facilitate capturing comments and interviews.
- The Design C2IS shall convert voice to text. Rationale: to expedite the development of work products derived from voice recordings.
- The Design C2IS shall provide integrated group access to project information sources, work products, and collaboration mechanisms.
- The Design C2IS shall display using both individual work screens and multiple, large touch-screen displays.
- The Design C2IS shall print to standard and large format devices (i.e letter, tabloid, or plotter size paper).
- The Design C2IS shall convert freehand sketches to line and block graphics and military graphics. Rationale: to expedite the development of work products.
- The Design C2IS shall convert freehand writing to text. Rationale: to expedite the development of work products.

[46] COL Tom Hollis, *SAMS Seminar Leader* interview by Brad Gill, (October 2008).

- The Design C2IS shall provide means to conduct synchronous (voice, chat, and VTC) and asynchronous (email, file sharing, discussion groups, blogs, and wiki) collaboration.
- The Design C2IS shall provide means to facilitate and record discourse.

Usability

The Design C2IS shall provide the following usability capabilities.

1. The Design C2IS applications and large screen displays shall be operated with intuitive graphical user interfaces. Rationale: Automation should not slow the pace of creative thought or discourse. The users should be able to develop their system and operational maps and narratives without unnecessary delay. The Scribes should be able to keep pace with an active discourse.
2. Design C2IS applications sketching and mapping capability shall demonstrate the equivalent ease of use as a white board. Rationale: Automation should not slow the pace of creative thought or discourse. The users should be able to develop their system and operational maps and narratives without unnecessary delay. The Scribes should be able to keep pace with an active discourse.

Reliability

The Design C2IS shall provide the following reliability capabilities.

1. The Design C2IS shall provide capabilities with a Mean Time Between Failures (MTBF) of 1000 hours. Rationale: To avoid loss of Design artifacts between archiving events.[47]

[47] 1000 hours would permit the Design Team to develop products for 40 days without off-site archiving. This time frame is consistent with the duration of cumulative Design exercises conducted at the School of Advanced Military Studies.

Performance

The Design C2IS shall provide the following performance capabilities.

1. The Design C2IS applications and large screen displays shall provide responsive (sub-second) screen input and refreshes. Rationale: Automation should not slow the pace of creative thought or discourse.

Security

The Design C2IS shall provide the following security capabilities.

1. Commercial Off The Shelf (COTS) software applications are available for use in both classified and unclassified mode.
2. All ABCS information management functions shall be available in classified mode.
3. Collaboration functions shall be available in both classified and unclassified mode.
4. Communications access will be via both NIPR and SIPR networks.

Interfaces

The Design C2IS shall provide interfaces to: unit ABCS systems, unit communications and security systems, Joint C2 systems, DoD authoritative data sources, interagency authoritative data sources, and select multinational C2IS.

Gaps and Shortfalls

There is a variety of information system capabilities that are not currently provided either through current commercial or government information technology. These shortfalls should be purchased or developed. The Design Team may use common office applications for most activities and products. The Design Team may use existing Army Battle Command System as applicable. However, significant gaps and shortfalls do exist. The known shortfalls or Gaps are:

- Functionality Shortfall/Gap

    - Information organization and processing to support the efficient analysis of the environment and problem
    - Knowledge capture (audio, text, and graphics) and management,
    - Display using multiple large touch-screen displays,
    - Sketch-to-graphics processing,
    - Handwriting recognition,
    - Voice-to-text processing, and both
    - Synchronous and asynchronous collaboration.

- Security Shortfall/Gap
    - Information management functions shall be available in both classified and unclassified mode.

- Usability Shortfall/Gap
    - Sketching capability shall demonstrate the equivalent ease of use of a white board.

For most of these shortfalls, adequate technologies exist but merely need be applied, integrated, or tailored (e.g. environment frame graphics, wiki). A few shortfalls need technology maturation (e.g. speech-to-text conversion) and another select few require need operational analysis to support processing algorithm design (e.g. environmental frame analysis).

What Information Does the Team Need?

Information is the commodity of Design. Designers must absorb significant quantities of information in order to develop the deep, quality insight necessary to frame the system and the clarity of vision to conceive effective operations. Information is shared within the team when it is perceived as relevant within the scope of study and potentially significant in the formation of understanding or a theory of action. The shared information can be exchanged as found or may be paraphrased within the context of the group's theory of reality. The Design Team must synthesize information that is perceived as relevant and significant within a narrative for the executive sponsor as well as other staffs and staff elements. Information must be maintained throughout the course of

operations in order to find logic errors, keep track of changing situations, and to identify adaptations that were not anticipated.

Although Design is dependent upon information, from a practical perspective it is also inherently problematic. Designers deal with information of many types: encyclopedic information, authoritative and revisionist history, peer reviewed research, biased and objective news, facts, rumor, conjecture, opinion, lies, speculation, combat reporting, adversarial communications information operations, deception, and propaganda. One of the skills developed by a good designer is a discriminating sense that allows them to sort the accurate from the inaccurate and the significant from the insignificant. Each source should be vetted. Each piece of information synthesized or discounted. A useful practice for the scribe is to record (or link to) the metadata for information as it is collected (see Figure 23. Design Information Metadata Example). If possible, this is done in stride but if not should be done at the end of a research session (e.g. every 4-8 hours). The references that the metadata provide facilitate the management, organization, vetting, and retrieval of information.

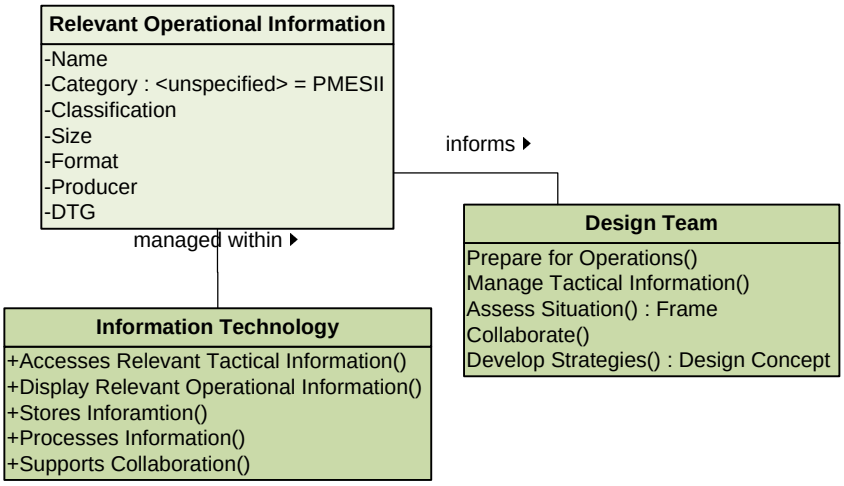


Figure 23. Design Information Metadata Example

The Design Team with the aid of their enabling information system infrastructure must acknowledge the information risks, ameliorate them when possible, and note inconsistencies for monitoring and follow-up. It is unlikely that an information technology system is going to capture and account for all flaws, qualities, and form variations foreseeable. Continued emphasis and investment shall decrease the information cacophony but ultimately the humans will have to be counted upon to do the final if not the majority of the information correlation supporting the Design.

The analysis and processing of information within Design transcends a categorical approach. Design relies upon development of a holistic understanding of the system that exceeds the capabilities of simple categorical analysis. Unfortunately, a holistic understanding is not something that can be instantaneously created. It must be developed incrementally through addition and correlation of contributing knowledge and insights. This incremental addition and correlation is facilitated by a categorical approach. Design could be conducted within a free flow of information and ideas but the use of a categorical technique assists in structuring the research and discourse. A categorical technique is also useful to the team, in that it provides a mechanism to evaluate whether they have overlooked an important aspect of analysis.[48] Design is a means to synthesize understandings and solutions to fully account for the relationships among information and their superficial categories so that a holistic view of the system and interventions are created.

All of the common categorical approaches to analysis have weaknesses that must be recognized and overcome within Design's synthesis and analysis. Using an existing

[48] For example, in one case study conducted within the School of Advanced Military Studies (AMSP 2009 Seminar 3 Practicum 1), a Design Team concluded their system framing without analyzing the militaries of the principal states and actors. The team did not use an articulated categorical approach.

categorical analysis technique may inadvertently influence the outcomes. A healthier technique may be to study the environment and see if any dominant categories emerge. If this technique is used the object relationships will likely fit the environment more closely that if a “foreign” categorization is forced unnaturally. Unfortunately, this technique will likely negate the use of automated application processing of the information due to the unpredictability of the information hierarchy, attributes, domain values, or relationships. The categorization process also imposes a false hierarchical and segregated view. This is a dangerous over simplification that blocks true understanding of complex systems. At least three other aspects have to be accounted for: the relationships between objects or categories, the nature and strength of relationships to inform causation and to both future potential and propensity, and the dynamics of change over time within the whole equation. The understanding of the relationships among the categories is the true essence of the system at work. The relationships are what make the system a system. The categorical analysis is only the necessary baseline information within which you can find and assess the relationships. Information categorization should be an assistant not a crutch to analysis.

Knowing this, the team should use the categories that feel the most natural and useful for them and relevant to the issue at hand. They should not have to use a prescribed method during analysis. If a variation on their existing categories presents itself then it should be used. However, there are drawbacks that have to be considered if deviation from a standard is elected. The first is that your data sources and applications cannot be expected to automatically organize or process the information. This decreases the value of available IT to the team. The second drawback is that both internal to the team and possibly more importantly external to the team the new categorization approach may cause confusion and misunderstanding. Both standardization of the categories or use of a well known categorization (e.g. DIME, METT-TC, PMESI, and ASCOPE) have

enterprise value. Standard categories expedite analysis, provide subgroup scope, provide a common lexicon, and simplify external presentation and understanding. There are a number of legitimate frameworks available to conducting a categorical analysis within a Design Team. Some of them are: DIME (see Figure 24), PMESII+PT (see Figure 25), METT-TC (see Figure 26).

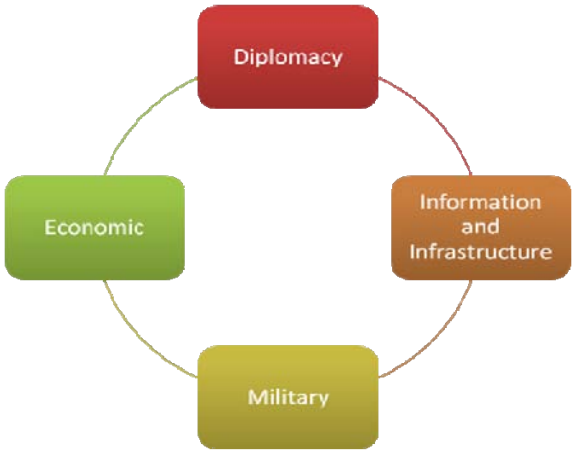


Figure 24. Information Categories using DIME.

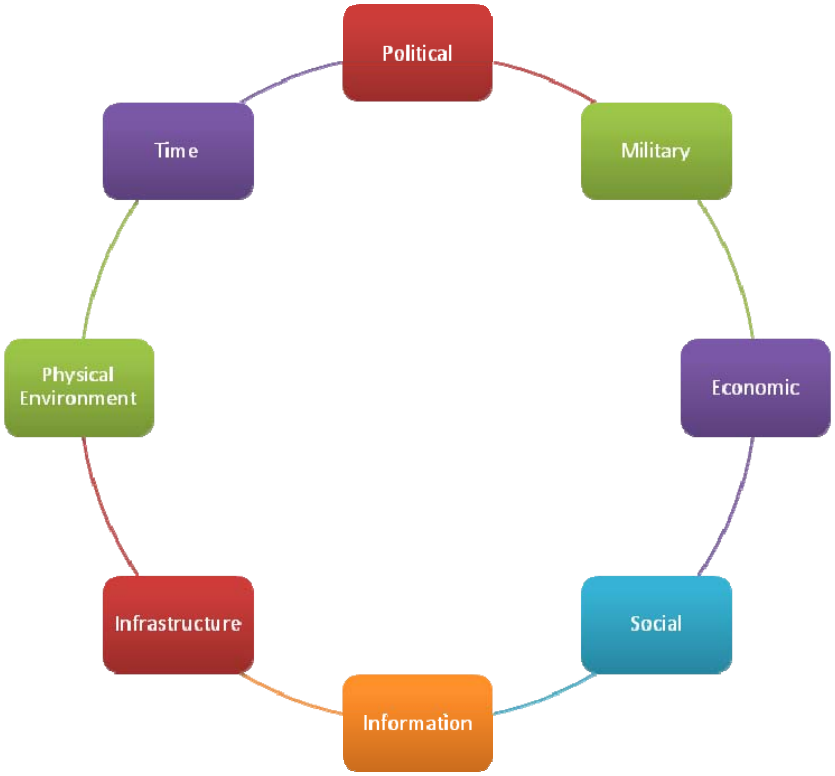


Figure 25. Information Categories using PMESII+PT.

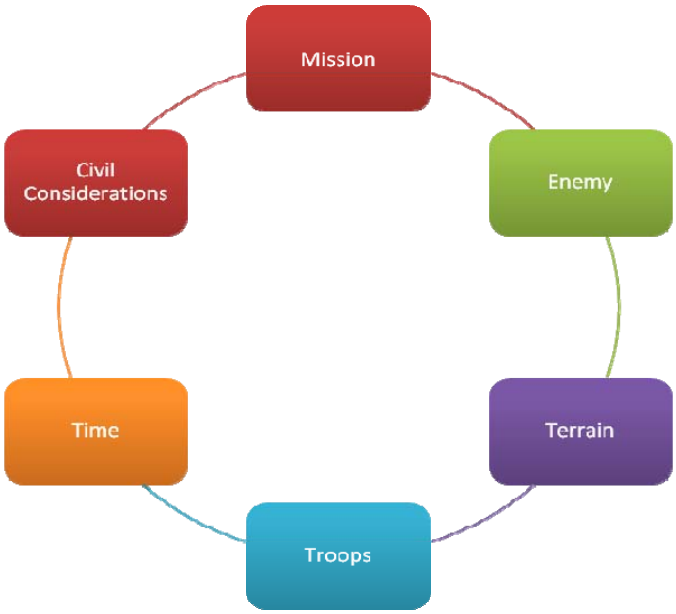


Figure 26. Information Categoies using METT-TC.

The “Civil Considerations” within METT-TC is further subcategorized into ASCOPE (see Figure 27).

Figure 27. Subcategories of METT-TC Civil Considerations.

Some have made compilations of multiple categories. The Combined Analytical Framework (also illustrated in Figure 28. Combined Analytic Framework information categories) identifies the following categories:

- Physical Environment
    - Terrain/Space
        - Areas
        - Structures
        - Observation & Fields of Fire
        - Cover & Concealment
        - Obstacles
        - Key Terrain
        - Axes of Approach
- Nature of the State
    - Political System
    - Economic
    - Finance
    - Security
    - Legal/Law Enforcement
    - Technology
    - Information
    - Infrastructure
    - Capabilities/Services
    - Sanitation/ Sewer
    - Water
    - Electricity
    - Transportation
    - Medical
- Regional & Global Relationships
    - Diplomacy
    - External Organizations
- National Will
- Socio-Cultural Considerations
    - Society
    - Culture
    - Demographics
    - History

    - Narratives
    - Organizations
        - Tribes
        - Institutions
        - Markets
    - Networks
    - People
    - Events
    - Grievances
- Military
    - Doctrine
    - Organization
    - Training
    - Materiel
        - Weapons
        - Communications
    - Leadership/ C2
    - Personnel
    - Facilities/ Safe Havens
    - Intelligence
    - Maneuver
    - Fires
    - Logistics/ Support
        - Finance
        - Movement
    - Force Protection
    - Ideology
- Time

Although less well known, Design would also be well served by another categorization. It is the Twelve Critical Variables from the University of Foreign Military and Culture Studies (UFMCS) Red Team Handbook.[49] It lists the following categories:

[49] University of Foreign Military and Cultural Studies, *Red Team Handbook*, v. 4, (2007), 53-61.

- Physical Environment
- Nature and Stability of Critical Actors
- Sociological Demographics
- Culture
- Regional and Global Relationships
- Military Capabilities
- Information
- Technology
- External Organizations
- National Will and Will of Critical Actors
- Time
- Economics

The Red Team Handbook suggests the use of these categories for analyzing an operational environment. The various information categorization options for analysis are numerous and all have some utility and drawbacks. The Team Leader should evaluate them as options when considering the nature of the problem and the time available for analysis.

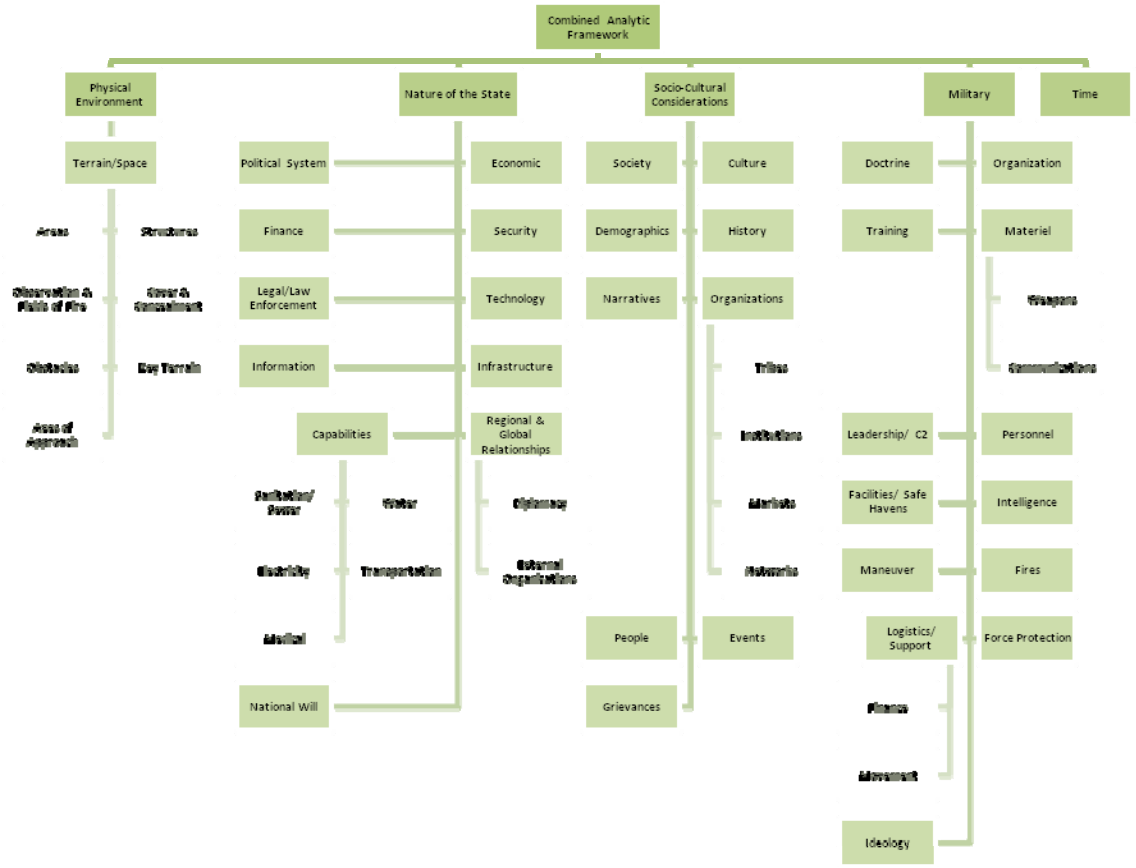


Figure 28. Combined Analytic Framework information categories

How Should the Team Use Its Time?

Because Design utilizes techniques that normally require significant amounts of contiguous time, time is a resource that must be considered and managed. Regional familiarity expedites Design activities. The immediacy of the global or operational situation also has a very significant impact on the execution of Design.

Familiarity with the regional situation greatly accelerates Design activities. Preferably, Design is conducted during contingency planning when familiarity can be extended and matured. This permits the team to conduct Design without forcing the discourse, critical thinking, and reflection. However, even in contingency planning there are reasonable limits to how much time is available. It is quite likely that in this case the time budget may be driven by the availability of the external team members.

The overall time budget for Design is dependent upon many factors and should be thought of in the terms of days and weeks versus hours. Design applies iterative learning to accomplish it goals; therefore strict time allocations are not appropriate. In the course of Design activities the team may revisit previous research and analysis or surge forward to explore opportunities. The path of iterative learning does not lend itself well to Gantt Charts and Critical Path Method (CPM) scheduling. Various inquiries, paradoxes, re-scoping, and categorical reassessment may stimulate a significant amount of iteration through the major work efforts. However, if a suspense date is imposed on the team activities, then the general orientation of work should be conducted using an informal time budget. The Team Leader should set the time budget using his experience with the team and the problem at hand. Since Design is a good example of discovery learning, a time budget should either explicitly account for multiple iterations or should allow for some form of slack or rework time that can be applied as needed. This “activity

orientation" allocation could be on the order of Preparation 5%, System Framing 30%, Operational Framing 20%, Strategy Formulation 15%; and a 30% slack buffer. One of the major responsibilities of the Chief of Plans is to guide the effective flow of the team's research, discourse, critical and reflective thinking, and creative activities within the overall budget.

The use of multiple iterations is similar to the Information Technology development concept termed *Spiral Development*. This is approach especially useful if the time available is very unpredictable. As in Spiral Development, if the Design Team iterates through the entire analysis cycle they have a deliverable at the end of each spiral and with each spiral the team enhances and improves the product.

Large groups may benefit by splitting into smaller groups in order to work in parallel versus sequentially through problem. For example, sub-groups may be based upon the team's categorization approach. Although some time is saved when sub-groups are used in parallel; the time savings is not what you may expect. In Design, it is unlikely that the sub-groups can be given tasks that are truly independent. Design is typically called for when dealing with complex systems and ill-structured problems. In these situations, the subgroup learning has to be communicated to the other members of the other groups and the full team now has to absorb this information into a larger holistic understanding. The introduction of new information and logic generates discourse that in turn has to be absorbed. Iterating through each groups learning may take a significant amount of time. The trap occurs when the reintegration is taking too much time and the team tries to move on without full knowledge. This leaves part of the group ignorant of the particular understanding integration that was skipped. The consequences of this trap can be worse than spending the time to conduct the analysis sequentially. If this technique is used then some of the worst consequences may be mitigated with frequent synchronization sessions.

Monograph Approach

The production of this paper was principally one of synthesis of applied research. A literature review of applicable products was conducted from primary sources (i.e. ARI, ARL, SAMS, BCBL, and other project team research) and secondary sources (Battle Command methodologies, project management, team learning, and problem solving). Three Design practicums within the SAMS curriculum were analyzed. Design sessions in preparation for Unified Quest 09 and Omni Fusion 09 were analyzed. Interviews within the Design Community of Practice and within the Battle Command methodology Community of Practice were conducted. Dominant views/practices were identified. The results of literature review and interviews were synthesized. The coherencies of the individual aspects of practice were verified.

Opportunities for Further Analysis

Continued analysis of Design within the context of Battle Command methodologies will provide additional insights, refinements, and extensions. M ore explicit analysis of the team organization and support approaches can be conducted after the Design workflow and supporting techniques are further documented. Detailed documentation will provide a opportunity to develop supporting software applications tailored to facilitate the specific design techniques. A detailed process analysis would identify detailed information technology application requirements in addition to many useful work aides and product templates. Further analysis will also contribute to the refinement of categorical analysis methods and Battle Command information management doctrine. Specific topics for analysis are identified in Table 1. Topics for Additional Research.

Table 1. Topics for Additional Research

Research Question	*Product*
What graphical techniques should be used to develop framing artifacts within a Design method?	A graphical technique for a system and operational mapping (this could be identification of an existing technique that is tailored to support mapping or documentation of a technique that would require new development or significant modification of an existing tool (Hypothesis – a stereotyped UML Object Model will support mapping activities within a Design method)
What information elements are necessary to support system and operational framing analyses within a Design method? ***OR*** ***What logical extensions are required to use the Joint Command, Control, and Consultation Information Exchange Data Model (JC3IEDM) in support of Design application development and Battle Command system integration***	The information syntax and semantics (a logical data model) for describing the information necessary to support system framing and operational framing. In order to facilitate standardization, training, and potentially the development of a framing application. Such a data structure is a precondition for development of reasoning (algorithmic logic) within a system application. Hypothesis – The Joint Command, Control, and Consultation Information Exchange Data Model (JC3IEDM) will initially support the capture and information analysis of Design information with a limited extension of data entities, relations, attributes, and legal values. Additional/extended data structure will likely be needed as additional design logic emerges.
How do individual and group cognition and double loop learning activities interact within the workflow of an interactive design team method	Nested activity interactions/workflow/ conceptual process that will clarify the interplay of individual and group learning and creativity to achieve Design function objectives
What is a practical method for conducting Design activities	The design method coherently documented –a Design how-to-guide (e.g. tenets, guidelines, patterns, anti-patterns, workflow, tasks, techniques, artifacts, tools)
What are the threshold and objective system capabilities needed to support a Design method?	A full set of detailed requirements for an integrated Design information technology system/environment – e.g. displays, input methods, processing functions, and interfaces
What are the near and long term information technology opportunities to support a Design method?	An emergent technology review mapped to the major Design information technology needs (threshold and objective)– this would outline a Science and Technology path for near term support as well as studies, Research and Development, and Army Technology Objectives
How could a Design team apply a personality profiling technique to entities within a system in order to understand needs, potential, and propensity	An investigation of how the symmetry of personal behavior may be replicated within coherent groups as a distinct cultural predilections; and how this understanding can be applied to understand and predict large group/state behavior
What biological theories can illuminate understanding of entity/system dynamics/causality	Ecosystems, islands, bottlenecks, evolution, growth, specialization, generalization, symbiosis dependency

Conclusion

Current operations indicate that improvements are warranted within our Battle Command planning method. The United States Army is currently conducting Stability Operations in Afghanistan (Operation Enduring Freedom) and in Iraq (Operation Iraqi Freedom). These operations have proven to be complex and are exemplars of ill-structured problems. Experience within these operations has demonstrated to the Army that our doctrinal Battle Command methodology does not adequately describe the techniques of Battle Command planning for use within these challenging situations. Although the planning doctrine is broadly supportive of all operations, it has been criticized as being overly prescriptive and sub-optimized to better support planning of conventional offensive or defensive operations against a symmetrical military adversary.

This seeming shortfall could be seen by some as a contributor to the limited success seen so far within OEF and OIF. Projections for the future of world conflict forecast that the armed forces of the United States are likely to conduct operations in equally complex environments and be faced with additional ill-structured problems. Recognizing the significance of this issue has stimulated research and analysis in evolving our planning doctrine to better accommodate current and future operations. Within this retrospective time, several modified approaches have been reviewed and synthesized into a general theoretical method currently addressed as “Design” or “Operational Design” and by some as the “Art of Design”.

A *practice* of Design is necessary to facilitate the employment of Design theories within operational forces. Design analysis so far has focused more upon the theory and less upon the actual practices of Design. Guidelines for conducting Design within Army forces do not exist within doctrine or SOP. There are no descriptive guidelines for the

organization (team size, roles, and responsibilities), management (time, workflow, artifacts), or support environment (infrastructure and tools) of the design team.

The Design practices identified within this paper should be understood as a baseline that can be tailored by an operational force Design Team (see Figure 29. Design Team Organization and Support). Design teams have to adapt their practice of design to their own particular situations. The theories contributing to our understanding of Design can be instantiated widely. The various types and style practiced may vary in form and degree consistent with the situation and circumstances faced by the Design Team. The Design Team should consciously assess its internal practice and adapt it according to need. In order to improve the effectiveness and efficiency of a design team, this document provides a set of guidelines for conducting design and considerations for modifying or extending them.

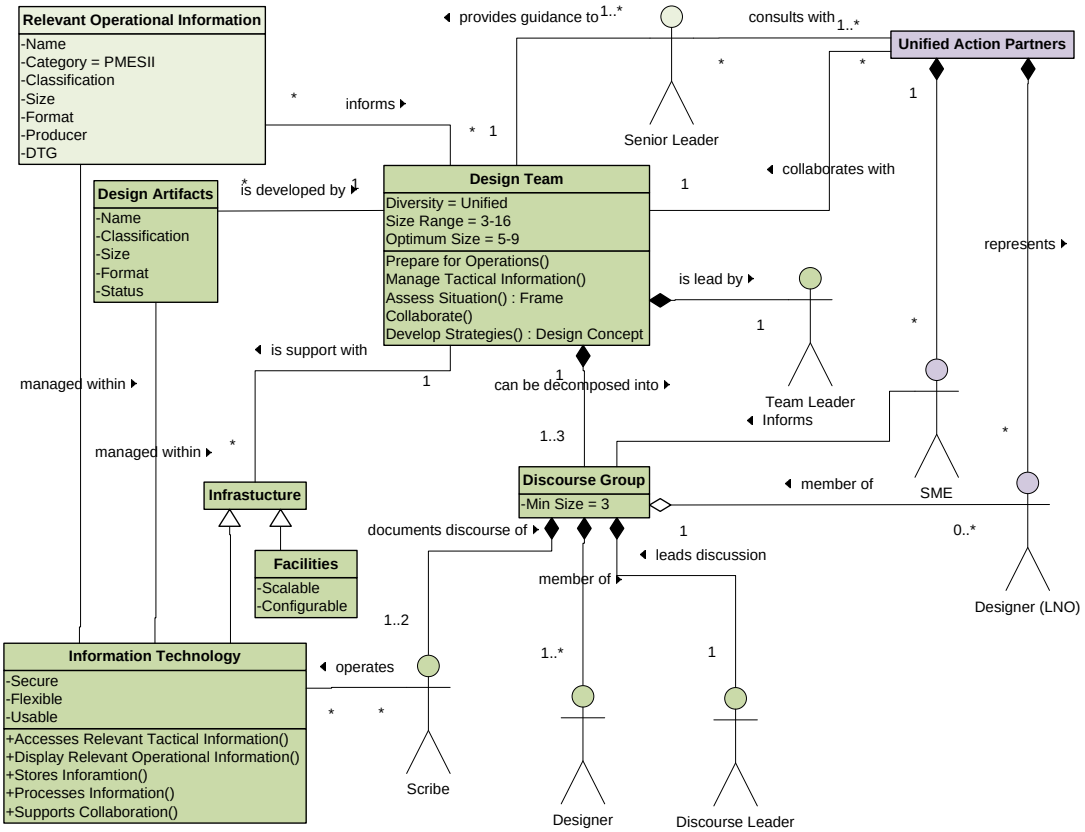


Figure 29. Design Team Organization and Support

Considerations for adaptation include command guidance, the initial impressions of the situation risks and challenges, the team's familiarity with situation, the team's makeup and capability, time available, and support environment available.

The Design Team base composition should include a Senior Leader (e.g. CDR or CoS), Team Leader (e.g. Chief of Plans), and a few of the Plans Officers (e.g. operations, intelligence, sustainment, and fires). The Chief of Plans performs the role of Design Team Leader in the absence of the Commander. One of the functional area plans officer would also function in the role of Scribe. Additional Design Team members are added to the core based upon the match between their expertise and the unique nature of the situation. In an effort to both gain diversity and additional expertise, additional Design Team Members should be integrated from cooperating stakeholder organizations (e.g. Joint, Interagency, Intergovernmental, Multinational, NGOs, PVOs, academics, and others).

The commander should give careful consideration to the size of the design team. Although design can be performed by individuals, the methodology is intended for teams, because the purpose is to provide collective effort to support the commander's intuition. The relevant factors to consider for design team size include perceived time available, the breadth of knowledge relevant to the problem situation, the methods that will be used, the maturity of the team, and the specific personalities, skills, and experience of team members.[50]

There is a tradeoff between a team that is too small to contain the many different kinds of thought and knowledge needed for design, and too large to be manageable. A team of moderate size (i.e. five to nine) is manageable, efficient, provides adequate

[50] Developed in coordination with Dr Alex Ryan for use within FMI 5-2 Design, 2009.

diversity, allows for a moderate degree of specialization, and permits the team to split into subgroups while maintaining sufficient size to have a legitimate discourse. In order to achieve desired diversity and depth of knowledge, within these size ranges, approximately one quarter to one third of the designers are likely to be personnel from outside the organization (i.e. joint, interagency, intergovernmental, multinational). The practice of design is sensitive to the quality of its participants. A small experienced group is preferable to large group of inexperienced personnel. Additionally, if an existing group is practiced in design and has a good knowledge of the problem domain it may not be prudent to modify their team dynamic by making changes in the size and composition of the team.[51] The design team size could range from three to fifteen with five to nine probably being optimum for most situations. The valued contribution of each additional team member must be factored against the exponential increases in time required for each member to learn and contribute, for the team to synthesize the contribution, and the team leader span of control.

The environmental enablers include a group meeting space that facilitates both independent research, group discourse, and design documentation. The team environment should include knowledge and information management and access tools to conduct research, visualize the system and operation, and to capture the associated narrative. So as it applies to Battle Command methodologies, more narrowly to planning, and ultimately to Design; information technology is a useful tool to a human planner. Information technology does not drastically change what is done, but rather provides a powerful tool or mechanism for how things are done better. Information technologies' primary and initial offering to a Battle Command planning methodology is currently the

[51] Developed in coordination with Dr Alex Ryan for use within FMI 5-2 Design, 2009.

ability to greatly accelerate the collection and sharing of information relevant to a planning or design activity. Objectively, Design C2IS capabilities may even provide means to process the current situation in order to project potential and propensities however; this is very optimistic and would require extensive analysis. More easily achieved would be for the Design C2IS to provide advanced display and input features, a tailored information management approach, as well as provide tailored system and operational map development capabilities.

During the conduct of Design analysis, some reductionist decomposition using categories (e.g. PMESII) is acceptable and common although potentially not optimum. No one categorical scheme is prescribed. If conducting categorical analysis, a team should use a familiar categorization scheme and adjust it as they learn the environment.

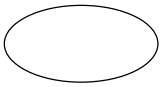
Because Design utilizes techniques that normally require significant amounts of contiguous time, the conduct of Design is preferably executed during contingency planning. The overall time budget for Design is dependent upon many factors and should be thought of in the terms of days and weeks versus hours. Within the overall budget for Design the iterative learning activities occur; therefore strict time allocations are not appropriate.

APPENDIX A Unified Modeling Language Supplement

The Unified Modeling Language (UML) has been used in this document when applicable to illustrate various analysis concepts. The paragraphs below provide a very brief overview of those aspects of UML used.

A use case diagram shows the relationship among actors and use cases within a system. Use case diagrams show actors and use cases together with their relationships. The use cases represent functionality of a system or a classifier, like a subsystem or a class, as manifested to external interactors with the system or the classifier. A use case diagram is a graph of actors, a set of use cases, possibly some interfaces, and the relationships between these elements. The relationships are associations between the actors and the use cases.[52]


Actor: Generally, an external system or human user of the system being described. An actor defines a coherent set of roles that users of an entity can play when interacting with the entity. An actor may be considered to play a separate role with regard to each use case with which it communicates. The standard stereotype icon for an actor is a "stick man" figure with the name of the actor below the figure.[53]


Use Case:

A use case is a kind of classifier representing a coherent unit of functionality provided by a system, a subsystem, or a class as manifested by sequences of messages exchanged

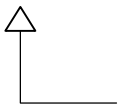
[52] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 233-235.

[53] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 219-223.

among the system and one or more outside interactors (called actors) together with actions performed by the system. A use case is shown as an ellipse containing the name of the use case.[54]

Association:

The participation of an actor in a use case, i.e. instances of the actor and instances of the use case communicate with each other. This is the only relationship between actors and use cases. An association between an actor and a use case is shown as a solid line between the actor and the use case.[55]



Generalization Relationship:

A generalization from use case A to use case B indicates that A is a specialization of B. A generalization between use cases or classes is shown by a generalization arrow, i.e. a solid line with a closed, hollow arrow head pointing at the parent use case.[56] Specializations inherit the characteristics of the generalizations.

A Class diagram gives an overview of a system by showing its classes and the relationships among them. Class diagrams are static -- they display what interacts but not what happens when they do interact. UML class notation is a rectangle divided into three

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[54] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 219-223.

[55] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 65-68.

[56] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 65-68.

parts: class name, attributes, and operations. Names of abstract classes, such as Payment, are in italics. Relationships between classes are the connecting links.[57]

A class diagram has three basic kinds of relationships: association, aggregation, and generalization. An association is a relationship between instances of the two classes. An association has two ends. The multiplicity of an association end is the number of possible instances of the class associated with a single instance of the other end. Multiplicities are single numbers or ranges of numbers. An aggregation is an association in which one class belongs to a collection. An aggregation has a diamond end pointing to the part containing the whole. Associations in which an object is part of a whole are aggregations. Composition is a strong association in which the part can belong to only one whole -- the part cannot exist without the whole. Composition is denoted by a filled diamond at the whole end. A generalization is an inheritance link indicating one class is a superclass of the other. A generalization has a triangle pointing to the superclass.[58]

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[57] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 105-108.

[58] Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, (Boston: Addison-Wesley, 1999), 65-68.

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